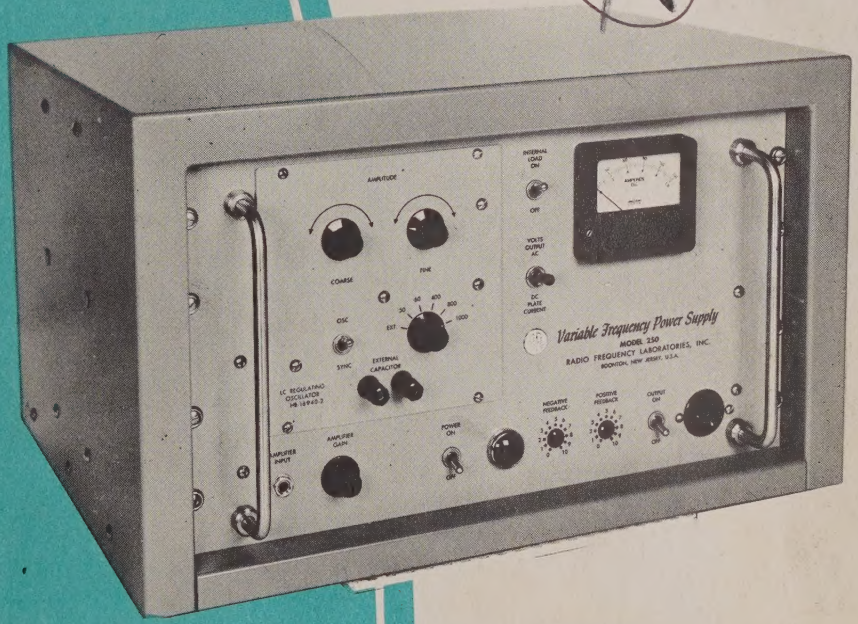
6-A-218

RFL

Model 250

Manual of Instructions



Variable Frequency Power Supply

Radio Frequency
LABORATORIES, INC.
Boonton, New Jersey, U. S. A.

Designers and Manufacturers of Electronic Equipment since 1922

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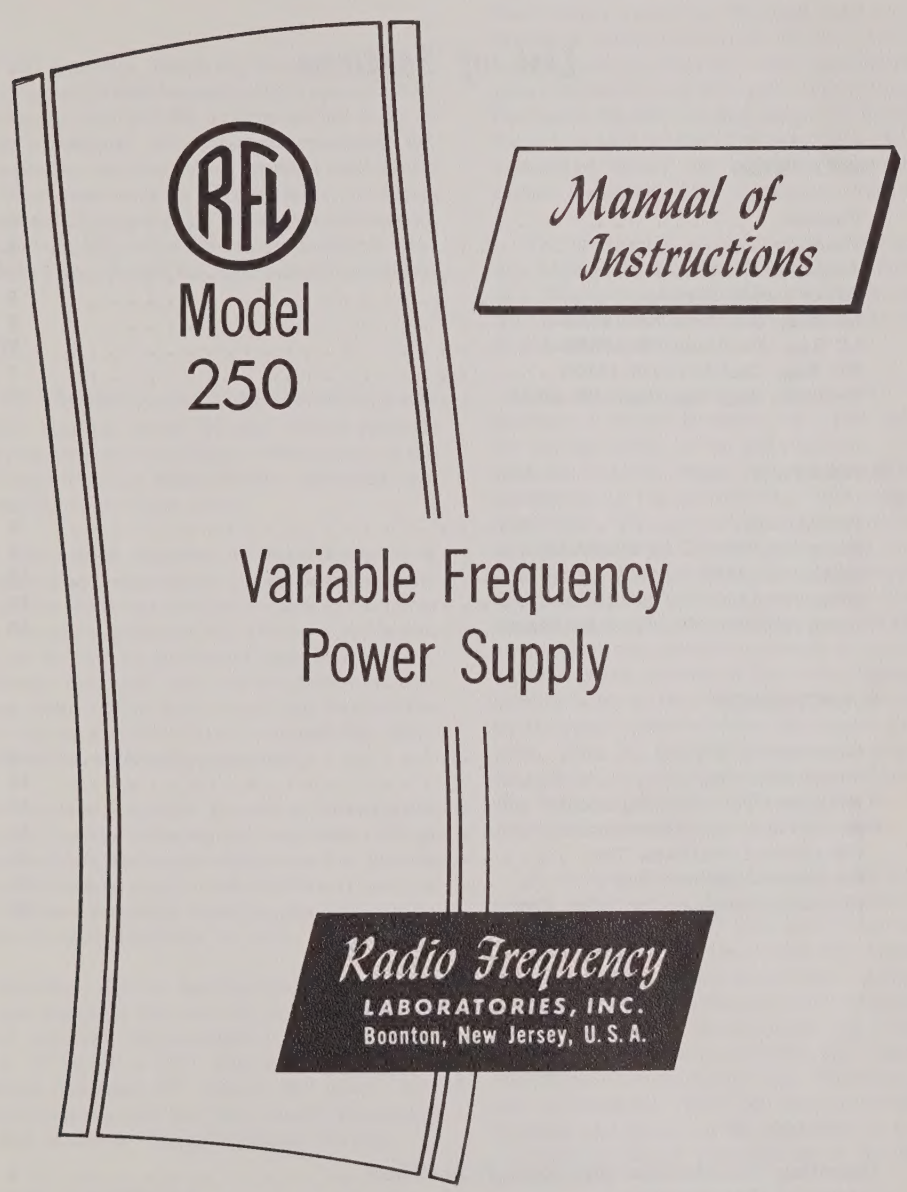

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Book No. MA-12830D

Table of Contents

List of Sections

DESCRIPTION

Purpose 3
Function 3
Amplifier Section. 3
Power Supply Section. 5
LC Reg. Oscillator HB-16940-2 5
LC Reg. Oscillator HB-12850-2 7
RC Reg. Oscillator HB-12800 7
Precision Reg. Oscillator HB-12900 7

OPERATION

Preliminary. 9
Using HB-16940-2 LC Oscillator 9
Using HB-12850-2 LC Oscillator 10
Using HB-12800 RC Oscillator 10
Using HB-12900 Precision Oscillator 10

MAINTENANCE

Disassembly 14
Troubleshooting. 14
Amplifier Test and Alignment 16
HB-16940-2 Oscillator Test. 17
HB-12850-2 Oscillator Test. 18
HB-12800 Oscillator Test. 20
HB-12900 Precision Oscillator Test. 20

List of Tables

Operating Characteristics with Optional Oscillators 8
Technical Data Summary 8
Troubleshooting Chart 15
AC Voltage Chart 18
DC Voltage Chart 19
Table of Electrical Parts 21

Description

PURPOSE

The Model 250 Variable Frequency Power Supply is a single phase, voltage regulated laboratory type power source capable of producing over 200 VA at frequencies from 30 to 3000 c/s. It is designed for continuous operation; all components, including vacuum tubes, operate well below rated values. When used with an LC oscillator, it is particularly recommended for powering instrument calibrators, such as the RFL Model 829 series, where low harmonic distortion and stability are desired for precise measurements.

FUNCTION

The Model 250 is basically a class AB_1 electronic power amplifier which may be driven by any of four optional oscillators or by an external oscillator. When none of the RFL oscillators are ordered, a blank cover is mounted over the oscillator cavity on the front panel.

Twenty to thirty db of negative voltage feedback is used to lower the output impedance and harmonic distortion of the amplifier. Voltage feedback tends to make the output voltage constant, irrespective of load impedance; this is the same as decreasing the output impedance of the amplifier. Voltage feedback also reduces harmonic distortion, because some of the distortion is fed back to the amplifier input and re-amplified so as to cancel the internal amplifier distortion originally generated.

The positive current feedback is used to increase the gain of the amplifier by reducing the negative voltage feedback proportional to the output current and so provide the extra drive needed to supply the additional current. By adjustment of these feedback controls, the unit can be made insensitive to changes of line or load.

All parts, including the air cooling fan, are mounted on the chassis and panel; so the unit can be removed from its cabinet and mounted on a standard 19" rack. The chassis/panel is 19" wide x $10\frac{1}{2}$" high x 14" deep. The aluminum cabinet measures 22" wide x 16" deep x 14" high over-all and extends over the front panel, protecting the voltmeter and controls. Weight is about 135 lbs.

AMPLIFIER SECTION

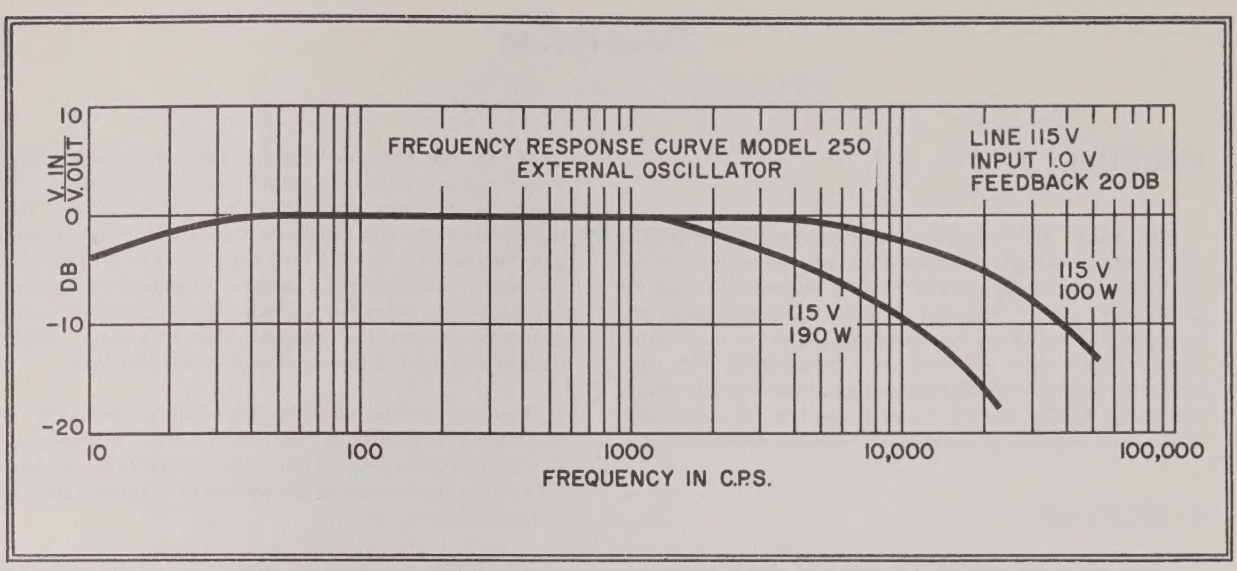
Refer to simplified schematic diagram. The output stage consists of two type 7378 pentode tubes working in push-pull class AB_1. These tubes are transformer coupled to the output load, one side of which is grounded to the chassis. The positive feedback controls allow a small voltage to be tapped off proportional to the current flowing in the load and fed back to the input. To this positive feedback is added degenerative voltage proportional to the voltage across the load by means of the NEGATIVE FEEDBACK control. The negative feedback network is designed so that at the full counter-clockwise position of the NEGATIVE FEEDBACK control there is about 4 db margin in the loop with a resistive 150-ohm load on the output. The feedback ratio or reduction in gain is 25 to 30 db. If the load is entirely removed under these conditions the circuit goes into oscillation with very high voltages existing across the output transformer and danger of insulation breakdown. For this reason a load of at least 10% of full-load must be connected across the output. The 250-ohm, 100-watt resistor mounted in the cabinet provides this load.

The preamplifier consists of a 6AU6 pentode tube used as a high gain amplifier. Two 12AU7 dual triodes are used as a direct coupled amplifier with cathode follower output. This arrangement reduces the number of coupling capacitors in the feedback loop.

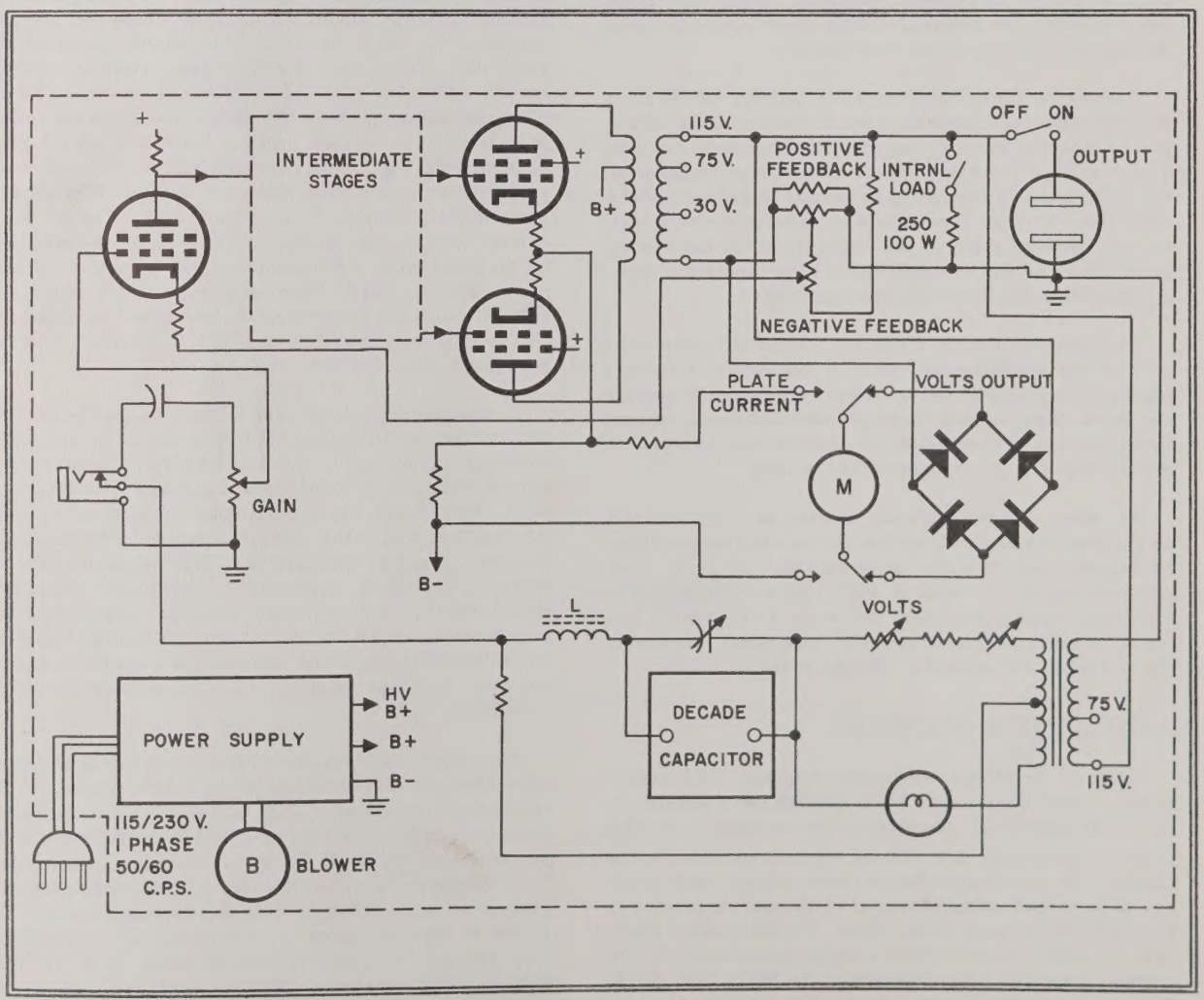
The voltage regulating tubes V101, V106 and V107 provide a stable B supply of +150 volts and -250 volts for the operation of the preamplifier. The output of the cathode follower stages V104A and V104B are directly connected to the grids of the 7378 output tetrodes V108 and V109. The grids of the 7378's are biased to approximately -43 volts. This bias voltage is controlled by the 25K potentiometer R112 (DC BIAS) located at the rear of the chassis. The balance between the 7378's grids is controlled by the DC BALANCE control R119. Test points are provided at the rear of the chassis to measure the bias voltage and plate currents of the output tubes. The DC BIAS control is set so that the total plate current, as measured by the panel meter with no input signal, is about 0.20 ampere. The DC BALANCE control is set so that equal currents flow in each tube. This is determined by measuring the voltage between TP2 and TP4 to chassis. The full load plate current is under 0.7 ampere.

A multitapped transformer is used to match the 7378 output tubes to the load. The nominal 115-volt output winding is tapped at 75 volts and 30 volts. The maximum current rating on the lower taps is 2.5 amperes continuous duty. The 75-volt tap is provided for instrument calibration applications, as this voltage coincides with the ranges of many potential transformers. Best regulation will be obtained through the use of the LC Regulating Oscillator HB-16,940-2 on its 75-volt tap. Terminals and connections are provided on TB101 for the use of external feedback controls and the use of the amplifier as a feedback current regulator of equal precision as to its voltage regulating properties.

The open loop frequency response of the amplifier is controlled at 6 db per octave above 2,000 cycles with the lag network composed of C105 and R107. The open loop frequency response below 40 cycles is controlled at 6 db per octave by the small value of coupling capacitor C106. The frequency response of the output transformer is approximately 10 to 30,000 c/s. This sacrifice in frequency response is required, since the load is part of the feedback loop and may be reactive. Loads made up of variable auto and fixed transformers become small reactive impedances at low frequencies and may require a reduction of negative feedback to 20 db to maintain stability.



Frequency Response of Amplifier with Resistive Load.



Simplified Schematic of Amplifier Section.

POWER SUPPLY SECTION

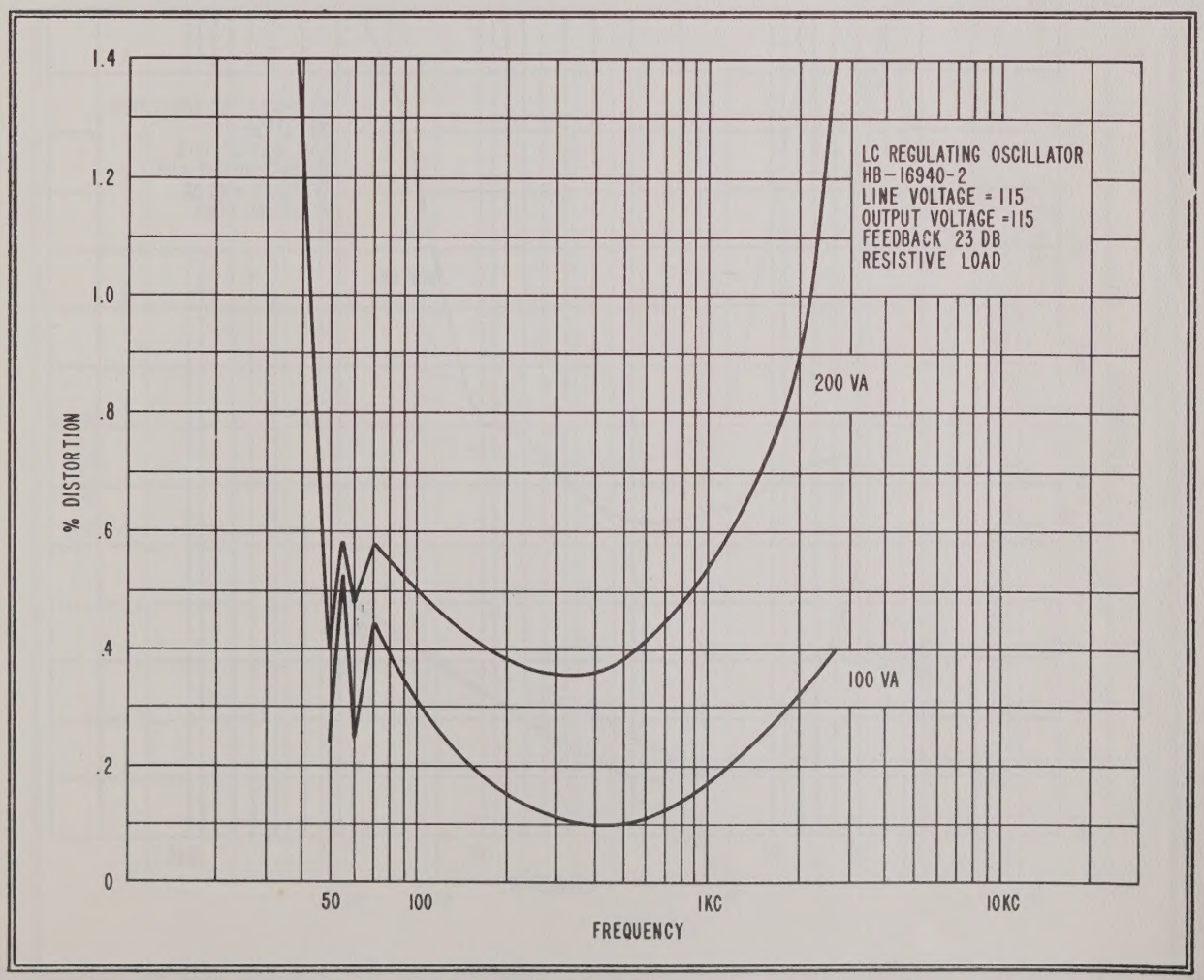
This section supplies 750 volts at 0.68 ampere to the plates of the 7378 output tubes and 275 volts to the screens. Regulated voltage sources of +150 and -250 volts are provided for the preamplifier. High voltage silicon rectifiers are used in the main supply and a 5Y3GT type tube is used for the low voltage supply. The transformer T102 can be connected for either 115-volt or 230-volt operation of the equipment. The case of electrolytic capacitor C108 is operated above ground potential.

LC REG. OSCILLATOR HB-16940-2

This combination consists of a thermal bridge and a frequency controlling LC filter in the feedback loop of the amplifier, making the entire circuit a controlled oscillator. The thermal bridge provides a factor of ten in regulation. This oscillator is recommended for use with the Model 250 in powering meter calibrators because of its high regulation and low harmonic distortion, particularly at 50 and 60 c/s where 3rd harmonic filters are employed to reduce distortion to a minimum (see curves).

The output voltage is restricted to 115 volts ±10% or to 75 volts ±10%. A 30-volt tap is provided at the rear of the chassis. The frequency is varied by adjusting the capacitance of the filter. Fixed positions for 50, 60, 400, 800 and 1000 c/s are provided. Terminals are available for connecting external capacitors, allowing operation at any frequency from 50 to 2400 c/s.

When connected into the amplifier the oscillator becomes a feedback loop around the entire amplifier. This loop then consists of the 115/75 to 35/35 VCT transformer T201, the thermal bridge consisting of thermal element RT201, and bridge arms resistors R207, R208, R209, R210 and R211, and the tuned filter consisting of the 9-henry inductance L201 and the variable capacitors. The output load is also a part of the feedback loop. The output at P202 is connected back to the input grid of the amplifier. Oscillations build up around this loop until the thermal bridge gains control of the amplitude. The frequency of oscillation is the resonant frequency of the filter. The magnitude of the output voltage is controlled by the bridge arm resistors. The 50-ohm rheostat R211 (marked VOLTS) and the 200-ohm coarse rheostat R207 are mounted on the front panel for output adjustment. The network consisting

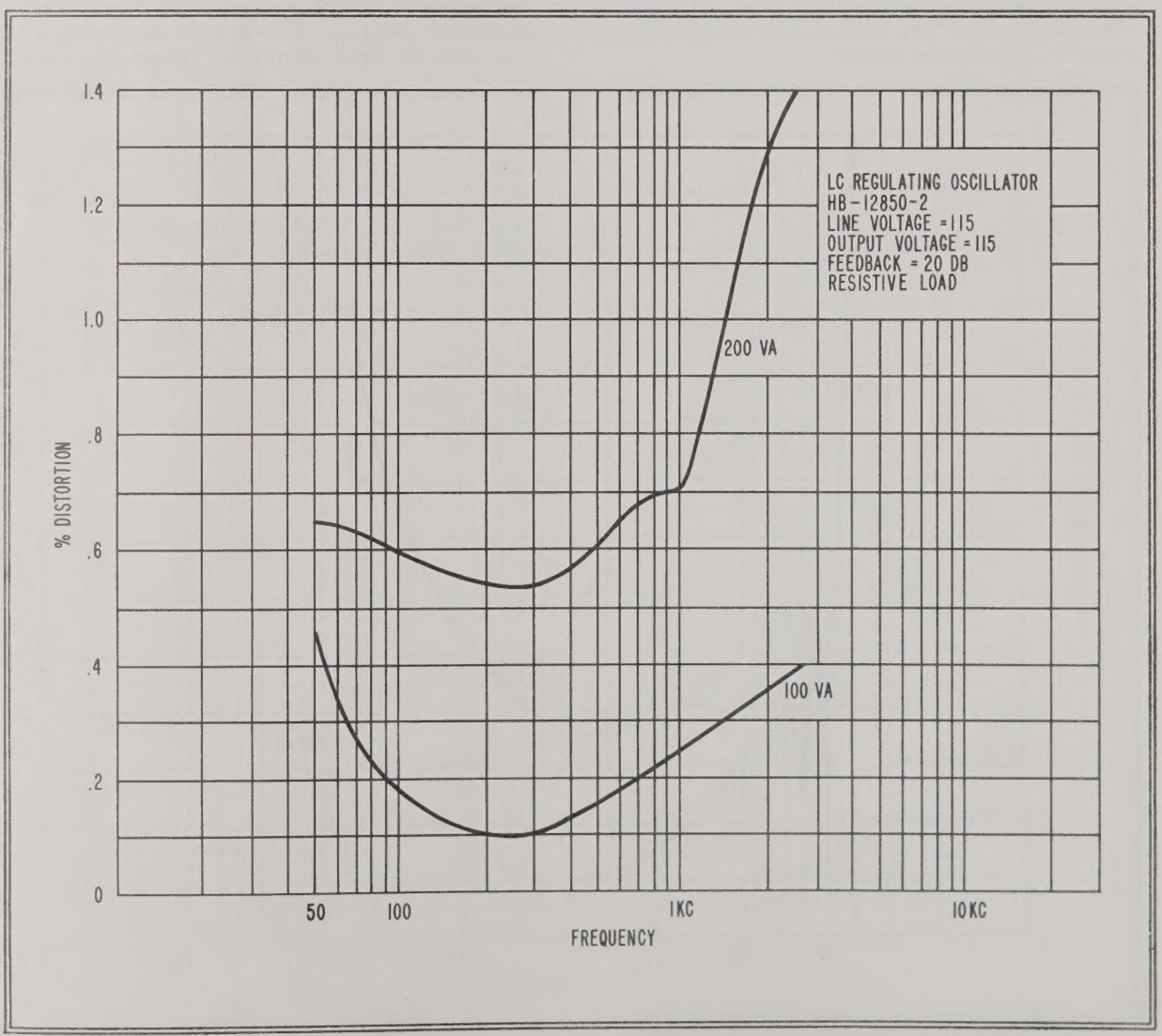


Harmonic Distortion of Model 250 with HB-16940-2 LC Oscillator.

of R203, R204, R205 and potentiometer R206 injects voltage into the loop; when the thermal bridge is balanced, the output at P202 to the first grid of the amplifier is approximately one volt. This provides full drive to the amplifier, the thermal bridge being in its most sensitive control region. When the OSC-SYNC switch is in the SYNC position this reference voltage is obtained from the filament voltage source, thus locking the oscillator to line frequency. The LC filter must be tuned to line frequency for locking to occur. Resistor R209 is a non-linear stabilizing resistor. Inductance L201 and capacitors C208 and C209 make up a 3rd harmonic reject filter for 50 and 60 c/s.

The thermal bridge, the filter and the amplifier can be analyzed as a simple AC servo loop with two poles in the open loop transfer function. As such, the system is stable but oscillatory. At frequencies below 50 cycles the transfer function of the amplifier may modify the transfer function of the AC loop to cause unwanted oscillations on inductive loads. This can be prevented by reducing the positive feedback of the amplifier at the expense of increased regulation to the load. Adding resistive load, either in parallel or series, with the line aids in preventing oscillation. Operation should not be attempted under 50 c/s or above 3000 c/s. Operation at 50 c/s on inductive loads may require that additional loading resistors be placed across the output load.

Terminals are provided on both ends of the SYNC network consisting of R212 and R214. If this circuit is broken and an external voltage of 6.3 volts, having the same frequency that the filter is tuned to, is applied to this network the loop is locked to its frequency. The phase of the amplifier output is then controlled by the LC filter. The voltage must be applied through a shielded transformer winding isolated from ground. In this manner, the excellent regulation and low distortion features of the circuit can be retained while operating from 60-cycle line frequency or from crystal controlled oscillators.



Harmonic Distortion of Model 250 with HB-12850-2 LC Oscillator.

LC REG. OSCILLATOR HB-12850-2

This unit is identical in principle of operation and use to LC Oscillator HB-16,940-2, except its harmonic distortion is slightly higher at 50 and 60 c/s and only two fixed frequency positions are provided at 50 and 60 c/s. Its major difference consists of variable air and decade capacitors to permit continuous frequency adjustment between 380 and 2400 c/s. Terminals are also provided for attaching external capacitances to yield frequencies from 50 to 2400 c/s. A graph for determining the value of capacitance for any frequency is given under OPERATION.

RC OSCILLATOR HB-12800

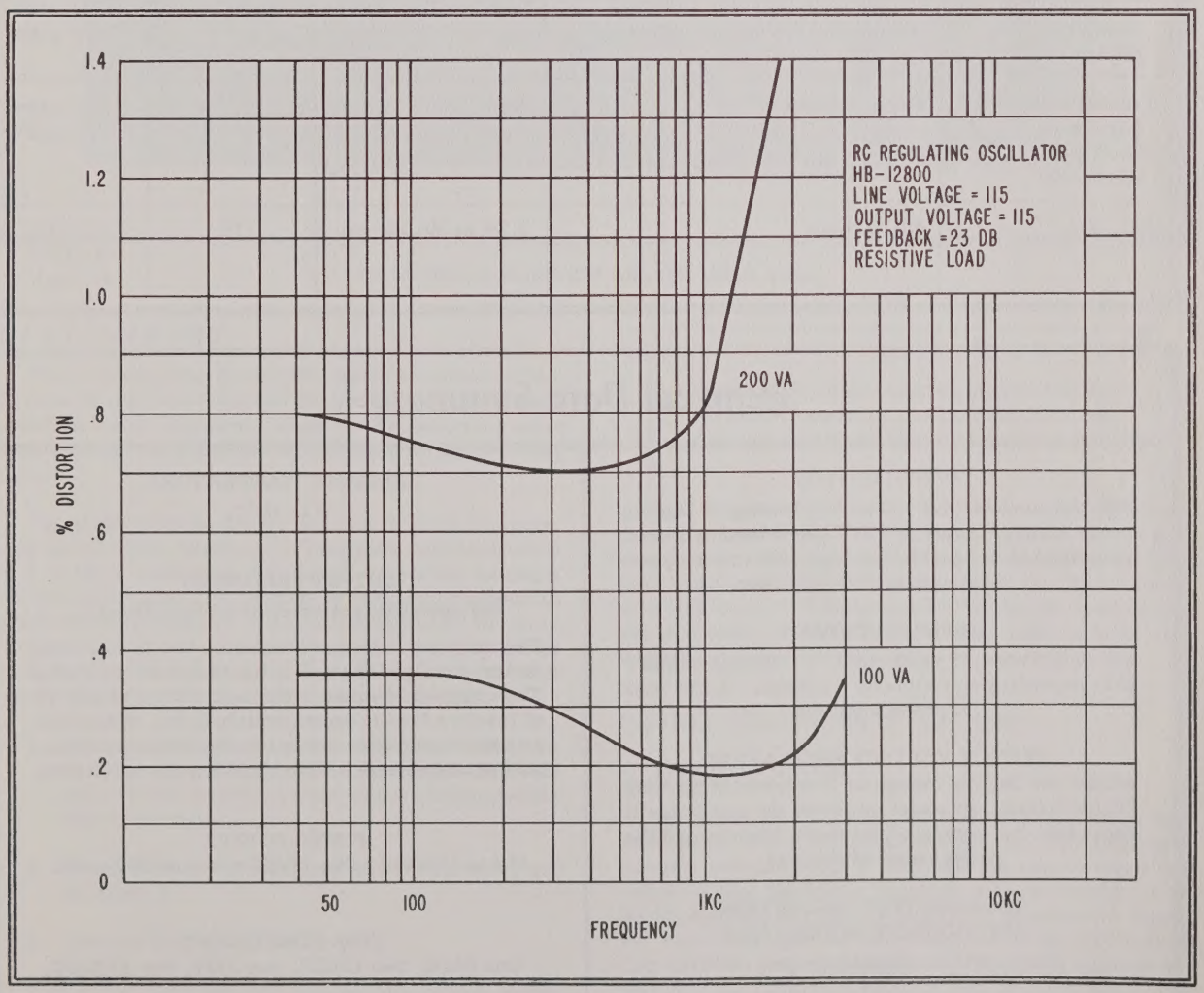
This oscillator provides low distortion and continuously adjustable output potentials from 0 to 130 volts. Output frequency is also continuously variable and is set by a direct reading dial to ±3%, which is driven through a gear reduction for smooth, accurate control. Three over-lapping ranges are provided: 40-200 c/s, 150-700 c/s and 600-3000 c/s. The oscillator is shielded in a steel case to minimize line frequency pick-up.

PRECISION REG. OSC. HB-12900

This unit consists of a thermal bridge, a 400 c/s filter and a controlling tuning fork oscillator. The frequency is stable to ±.005%, and the electrical characteristics are similar to the LC oscillators previously described, except for the single, fixed frequency.

On special order the circuit can be supplied for any frequency between 300 and 2000 cps with an accuracy of .005%.

The unit consists of the ratio transformer T-1, a thermal bridge, a tuning fork oscillator and a band-pass filter. The primary of T-1 is connected across the output of the power amplifier. The plug P-2 connects to the input grid of the power amplifier to form an oscillating feedback loop amplitude controlled by the thermal bridge and frequency controlled by the resonant frequency of the filter. Voltage from the tuning fork oscillator is injected into the loop through the filter network to lock the system to this precise frequency.



Harmonic Distortion of Model 250 with HB-12800 RC Oscillator.

OPERATING CHARACTERISTICS WITH OPTIONAL OSCILLATORS

OSC. TYPE	FREQUENCY	DISTORTION	REGULATION TO LINE OR LOAD	VOLTAGE OUTPUTS
RC Oscillator HB-12, 800	40-3000 cps direct reading ±3%.	1% at 45-600 cps.	1%	0-130 V 0- 75 V 0- 30 V
LC Regulating Oscillator HB-12, 850-2	50 and 60 cps fixed (not line frequency) 380-2400 cps var. Stability ±0.1% ±2 cps. 50-400 cps with external capacitors.	1% at 45-600 cps.	0.2%	115V ±10% 75V ±10%
	30-3000 cps for external osc.		1%	0-130V 0- 75V (2 amps) 0- 30V (2 amps)
LC Regulating Oscillator HB-16, 940-2	50, 60, 400, 800 and 1000 cps fixed; 50-2400 cps var. using external capacitors.	Less than 0.5%.	±0.2%	115V ±10% 75V ±10%
Precision 400 cps Regulating Oscillator HB-12, 900	400±.01% cps.	0.7%	0.2%	115V ±10% 75V ±10%
Ext. Osc.	30-3000 cps.	0.7% at 50-500 cps.	1%	0-130 V 0- 75 V 0- 30 V

Technical Data Summary

POWER OUTPUT

200 volt-amperes for 1.0 to 0.7 leading or lagging power factors. Derate to 100 VA at 0 leading or lagging power factor at 115-volt input; 250 volt-amperes maximum at 125-volt input.

OUTPUT VOLTAGE

105 to 125 volts, 28 to 32 volts, 70 to 80 volts adjustable depending on choice of oscillator. 0-130 volts as power amplifier.

OUTPUT VOLTAGE REGULATION

±0.2% for 5% line change or 25% load change with LC oscillators. As power amplifier the regulation is dependent on setting of feedback controls and the power factor of the load.

TOTAL OUTPUT DISTORTION AND ENVELOPE MODULATION

Varies with oscillator type (see curves).

AMBIENT TEMPERATURE

0 to 40°C.

OUTPUT FREQUENCY

See operating characteristics of oscillators.

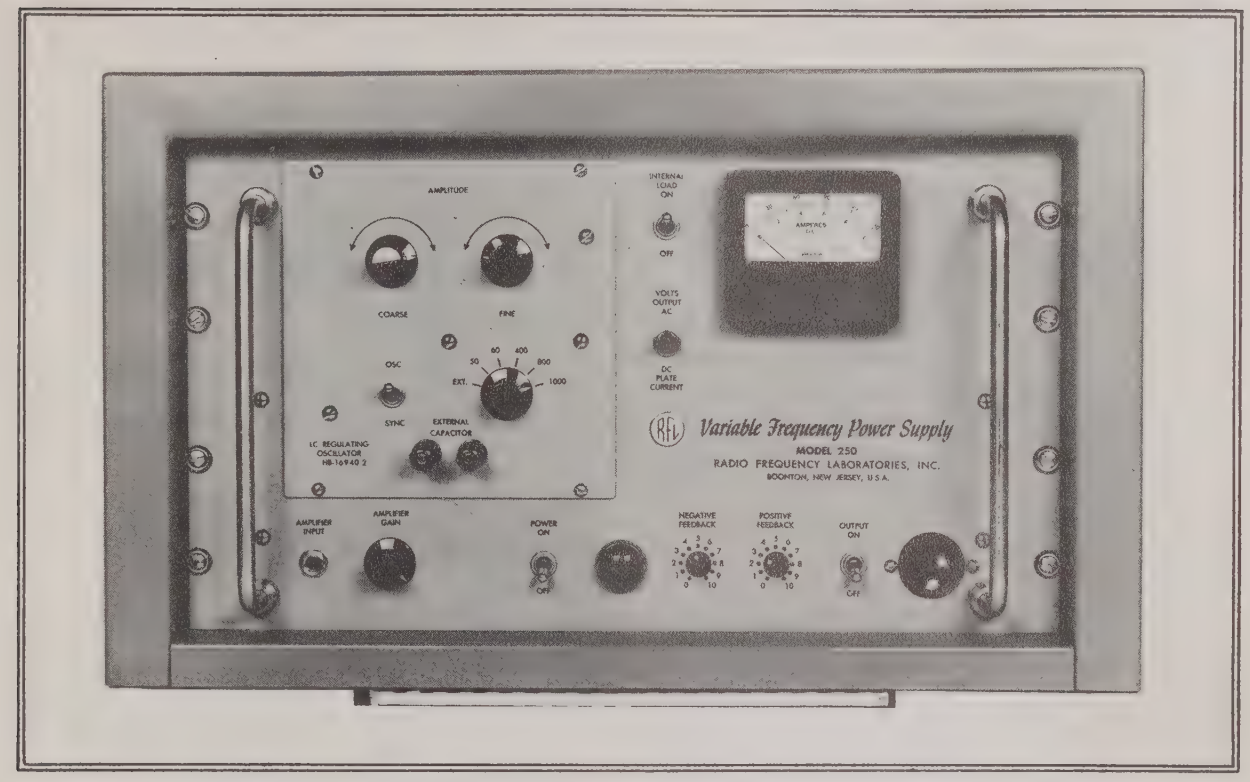
The variation of output frequency due to rated line and resistive load changes is less than 0.1% ±2 cycles. The change of frequency due to a change of 100 VA of reactive load is approximately 0.5%. When used as a power amplifier with external oscillator, the useful frequency range is 20 to 10,000 cycles at 100 watts.

POWER SOURCE

115 to 125/230 volts, 50/60 cycles at 650 watts.

TUBE COMPLEMENT

One 6AU6, two 12AU7, two 7378, one 5Y3-GT.



Front View of Model 250 with HB-16940-2 Osc.

PRELIMINARY

Upon receipt, the Model 250 should be removed from its packing crate and inspected for damage that might have occurred during shipment. Remove the perforated cover from the back and make sure all tubes and lamps are firmly seated.

Unless otherwise specified, the unit is wired for operation on 115 volts, 50/60 c/s. The power cord terminates in a 3-blade male plug for outlet receptacles having a ground connection. An adapter is supplied for situations where the line receptacle will accommodate only two connections; in this case, be sure to connect the ground lead on the adapter to AC ground. If not so supplied, the unit can be converted to 230-volt operation as follows:

1. Remove cabinet as shown under MAINTENANCE Section, turn unit on its side and locate terminal strip TB-102 located on under side of chassis opposite line cord entry.

2. Remove jumper connection between terminals 1 and 3, 2 and 4.

3. Connect terminals 2 and 3.

Plug power cord into line and connect load to Model 250 using the front panel receptacle or terminals 4 and 9 on the rear terminal board. Terminal 9 is ground. When testing and no external load is connected or when the external load draws less than 0.4 ampere, make sure INTERNAL LOAD switch (on front panel) is ON; this load consists of a 250-ohm, 100-watt resistive load. Do not operate the equipment without a load since, under no load, the amplifier may start oscillating.

NOTE

A free flow of air must be provided to the perforated areas of the rear cover or the equipment will overheat.

USING HB-16940-2 LC OSC.

A. Function of controls

There are four controls and two binding posts on the front panel of the HB-16940-2 oscillator, two amplitude controls marked COARSE and FINE are used to adjust the output voltage; an output frequency selector can be set to 50, 60, 400, 800 or 1000 c/s or to EXT positions for external capacitors that are connected across the EXTERNAL CAPACITOR binding posts for any frequency between 50 and 2400 c/s (values of external cap. to yield given freq. are given in a chart on page 11); and a toggle switch

marked OSC and SYNC is used to synchronize the output frequency to the power line frequency at either 50 or 60 c/s. (in SYNC position distortion of the output will be greater, depending on power line distortion).

B. Step-by-step operation

1. With POWER switch OFF, center both AMPLITUDE controls (white arrow up); INTERNAL LOAD switch ON.

2. Set frequency selector as desired and OSC-SYNC switch to OSC. To synchronize output with line frequency, set switch to SYNC and freq. selector to 50 or 60 c/s, depending on line frequency.

3. Throw POWER switch ON. If meter pointer rises above 0.4 ampere throw LOAD switch OFF.

4. Raise lever switch to VOLTS OUTPUT AC position and adjust COARSE and FINE AMPLITUDE controls on oscillator to desired voltage by observing meter.

5. Throw OUTPUT switch ON.

USING HB-12850-2 LC OSC.

A. Function of controls

There are five controls and two binding posts on the front panel of the HB-12850-2 oscillator. The amplitude control marked VOLTS 115 adjusts the output voltage; the FINE and COARSE FREQUENCY RANGE controls are used with the charts on pages 12-13 to set the output frequency within the range of 380 to 2400 c/s; a third frequency selector is used with the COARSE and FINE controls in the A or B position and also selects fixed frequencies of 50 and 60 c/s, plus an EXT position for using external capacitors for output frequencies between 60 and 380 c/s. Values of external capacitance to yield given frequencies are given in the chart on page 11.

B. Step-by-step operation

1. With POWER switch OFF, set amplitude control marked VOLTS 115 in center position (arrow pointed up). INTERNAL LOAD ON.

2. Set lower right-hand frequency dial on oscillator panel to 50 or 60 c/s or to range desired (if range A or B is chosen, set FINE and COARSE selectors as shown on accompanying chart for frequency desired) and OSC/SYNC switch to OSC. To synchronize output with line frequency, set switch to SYNC and lower right-hand dial to 50 or 60 c/s, depending on line frequency.

3. Throw POWER switch ON. If meter pointer rises above 0.4 ampere throw LOAD switch OFF.

4. Raise lever switch to VOLTS OUTPUT AC position and adjust VOLTS 115 control on oscillator to desired voltage by observing meter.

5. Throw OUTPUT switch ON.

USING HB-12800 RC OSC.

A. Function of controls

There are two front panel controls on the HB-12800 oscillator; both are used to set the output frequency. The one marked CPS and RANGE selects three bands: 40-200 c/s, 150-700 c/s and 600-3000 c/s; the other control operates a dial for selecting the desired frequency within each band.

B. Step-by-step operation

1. Set range control and frequency dial to desired frequency. INTERNAL LOAD switch ON (if external load draws more than 0.4 amp. throw LOAD switch OFF).

2. Throw POWER and OUTPUT switches ON.

USING HB-12900 PRECISION OSC.

A. Function of controls

There are three front panel controls on the HB-12900 oscillator. The control marked TUNING FORK OSC OUTPUT adjusts the amplifier output to 115 volts and is used with the SET LEVEL switch which opens the feedback loop. Once initial adjustment has been made with these two controls, the OUTPUT VOLTAGE control is used to set the desired potential.

B. Step-by-step operation

1. With INTERNAL LOAD switch ON throw POWER switch ON. If panel meter rises above 0.4 ampere, throw LOAD switch OFF.

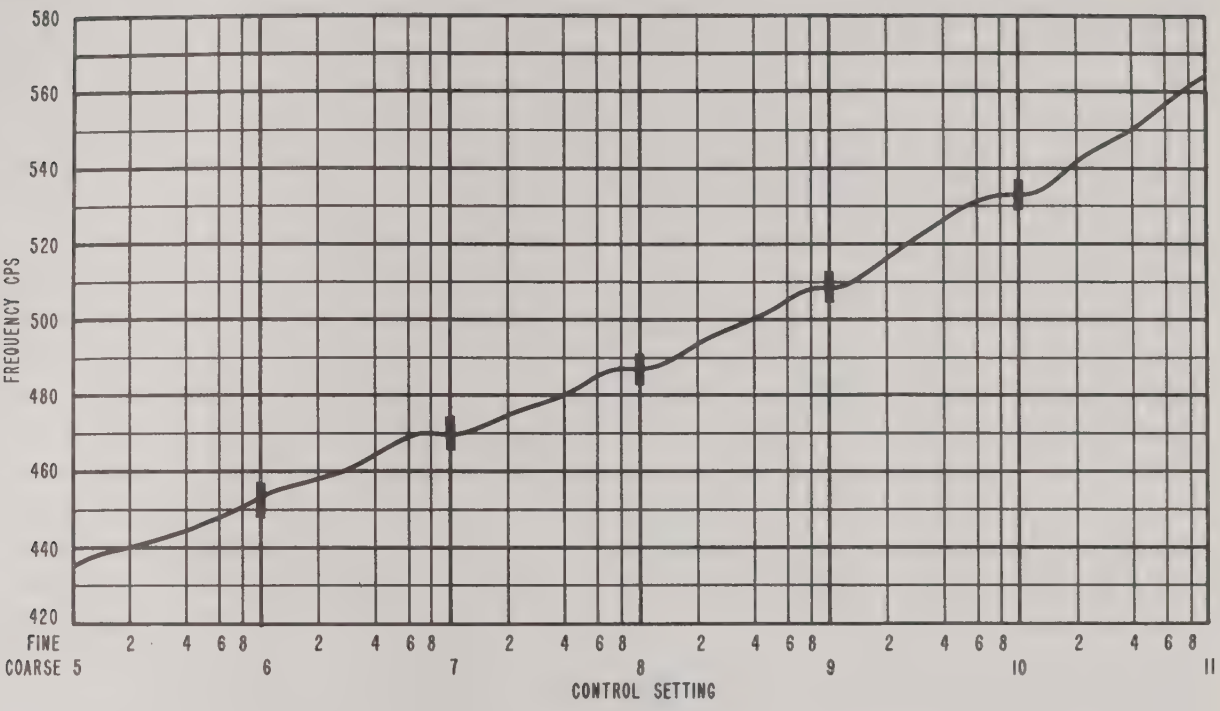
2. Depress switch lever on oscillator panel to SET LEVEL position and raise switch on amplifier panel to VOLTS OUTPUT AC; meter should read 115 volts. If it does not, hold both switches and ask someone to adjust TUNING FORK OSC OUTPUT control until meter reads 115 volts. This adjustment is periodic and requires only occasional checking - about once a day.

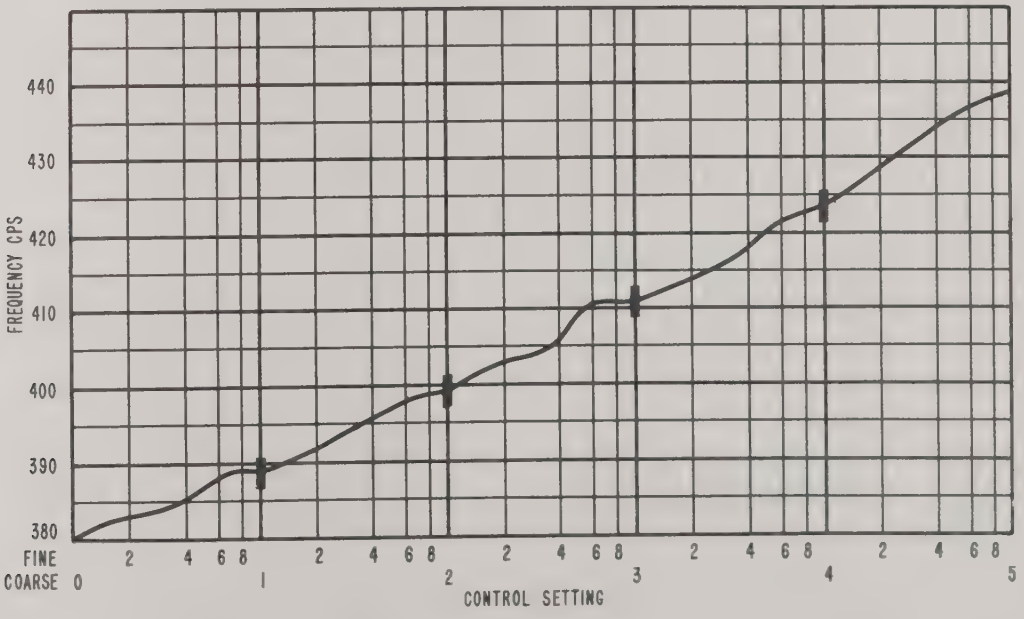
3. Output potential can be varied ±10% by raising switch to VOLTS OUTPUT AC and adjusting OUTPUT VOLTAGE control on oscillator while reading meter.

4. Allow five minute warm up after throwing POWER switch ON before use. Because of its high Q, the oscillator takes time to become stabilized.

Exterior Capacitance Values for Various Output Frequencies.

RANGE A

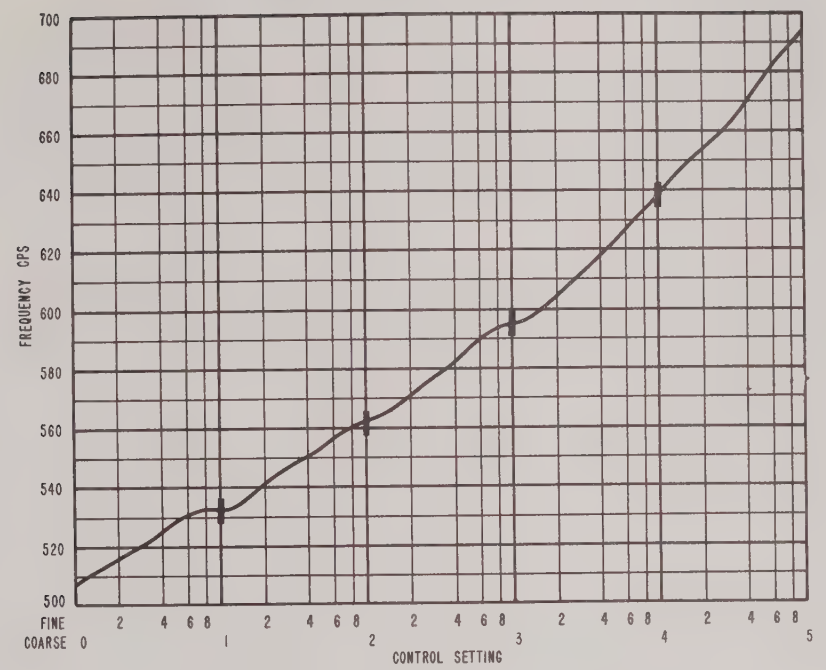


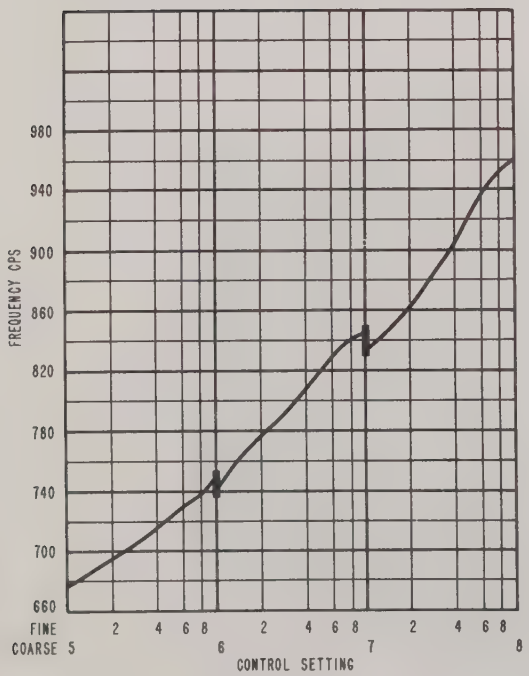


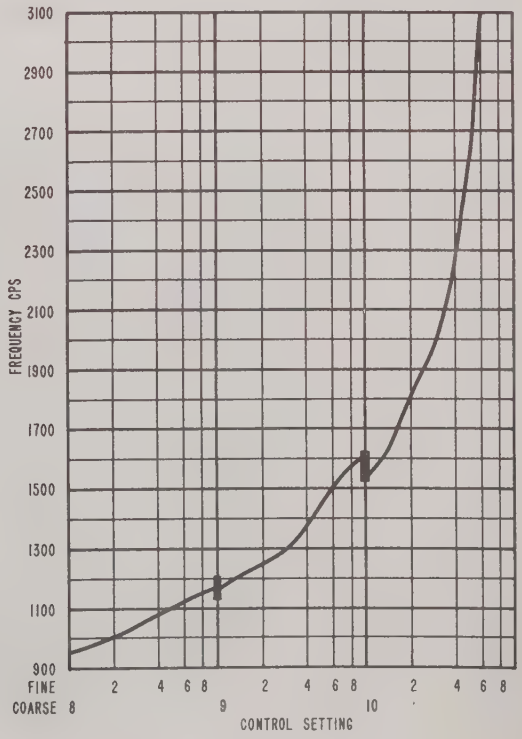
RANGE A

Setting of Fine and Coarse Dials
of HB-12850-2 Oscillator for Various Frequencies.

RANGE B







RANGE B

Setting of Fine and Coarse Dials
of HB-12850-2 Oscillator for Various Frequencies.

Maintenance

DISASSEMBLY

Make sure power cord is disconnected from line. To check components mounted on top of the chassis it is easier to remove the cabinet than the rear, perforated panel and, to check parts underneath the chassis, the cabinet must be removed.

The oscillator can be removed by unscrewing four screws (marked A in photo) which are located at each corner of its front panel. The oscillator can be replaced or repaired without removing the equipment cabinet.

To remove the cabinet, unscrew six truss head (B) screws (three on each side along lower edge) and eight (C) screws on sides of front panel. Lift cabinet straight up and off the chassis.

To disconnect chassis from bottom assembly, remove two (D) screws at bottom rear flange of chassis and two (E) screws at front bottom sides. The (E) screws enter the holding straps and are accessible through holes in the sides of the bottom plate.

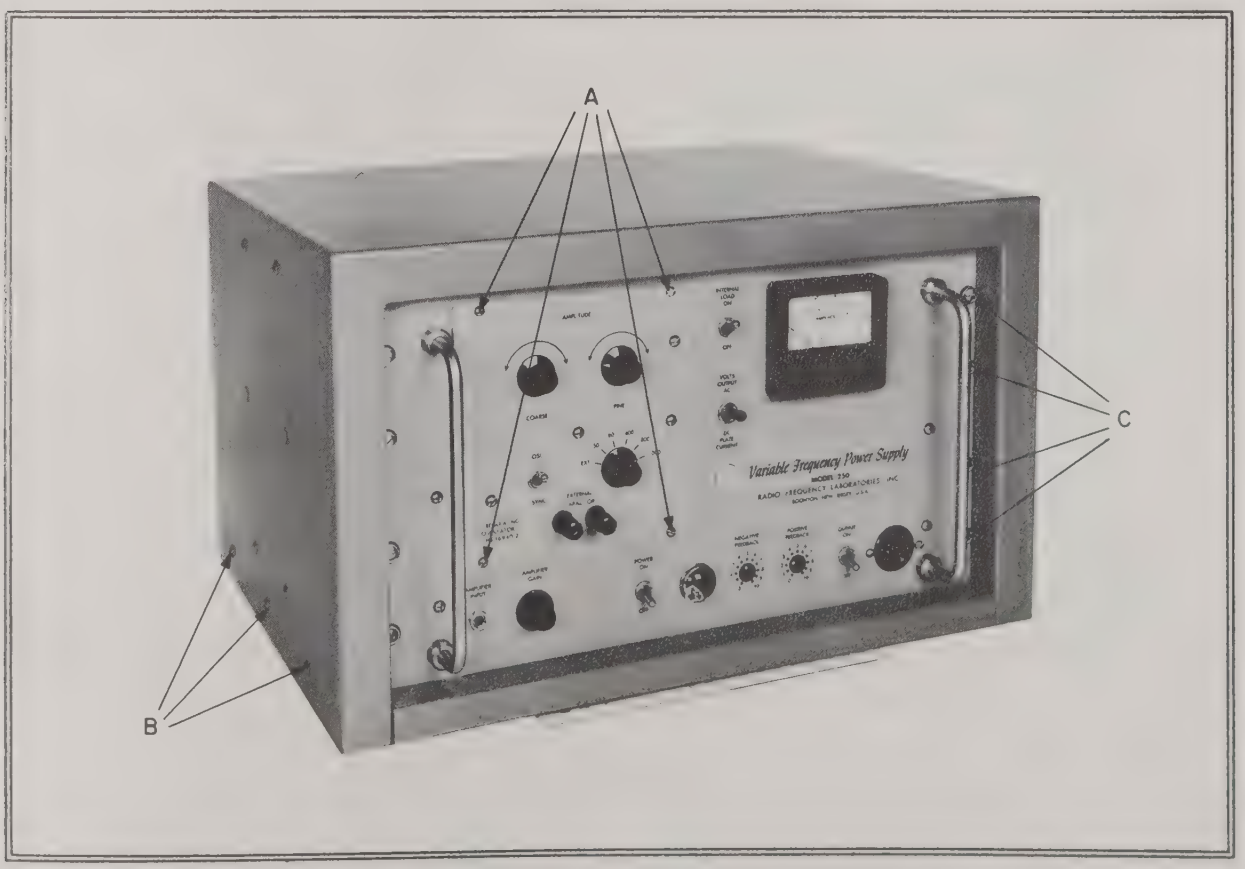
TROUBLESHOOTING

Component life can be extended by providing a free flow of air through the perforated back panel. Dust or other matter that may have been deposited by the fan circulation should be removed periodically.

The accompanying troubleshooting chart and tables of AC and DC voltages can be used as a guide in locating faults. Use a vacuum tube voltmeter for AC and a suitable 20,000 ohms/volt voltmeter for DC measurements. Unless otherwise specified, voltage measurements should be within ±3%.

SAFETY PRECAUTION

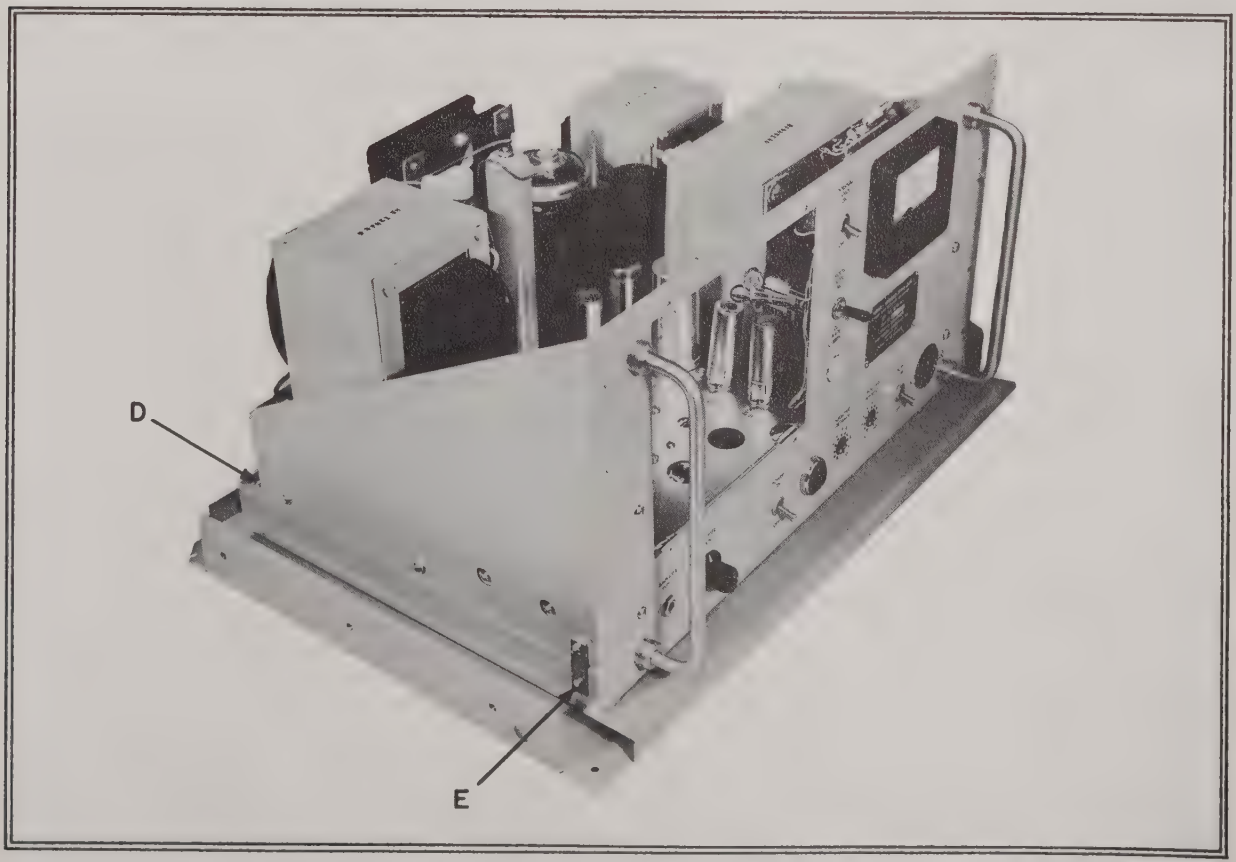
HIGH VOLTAGES EXIST INSIDE THE CASE OF THE MODEL 250 VARIABLE FREQUENCY AMPLIFIER. ONLY PERSONNEL TRAINED IN HIGH VOLTAGE TECHNICS SHOULD BE PERMITTED TO SERVICE OR TROUBLESHOOT THIS EQUIPMENT. THE CASE OF ELECTROLYTIC CAPACITOR C-108 IS 400 VOLTS ABOVE CHASSIS.



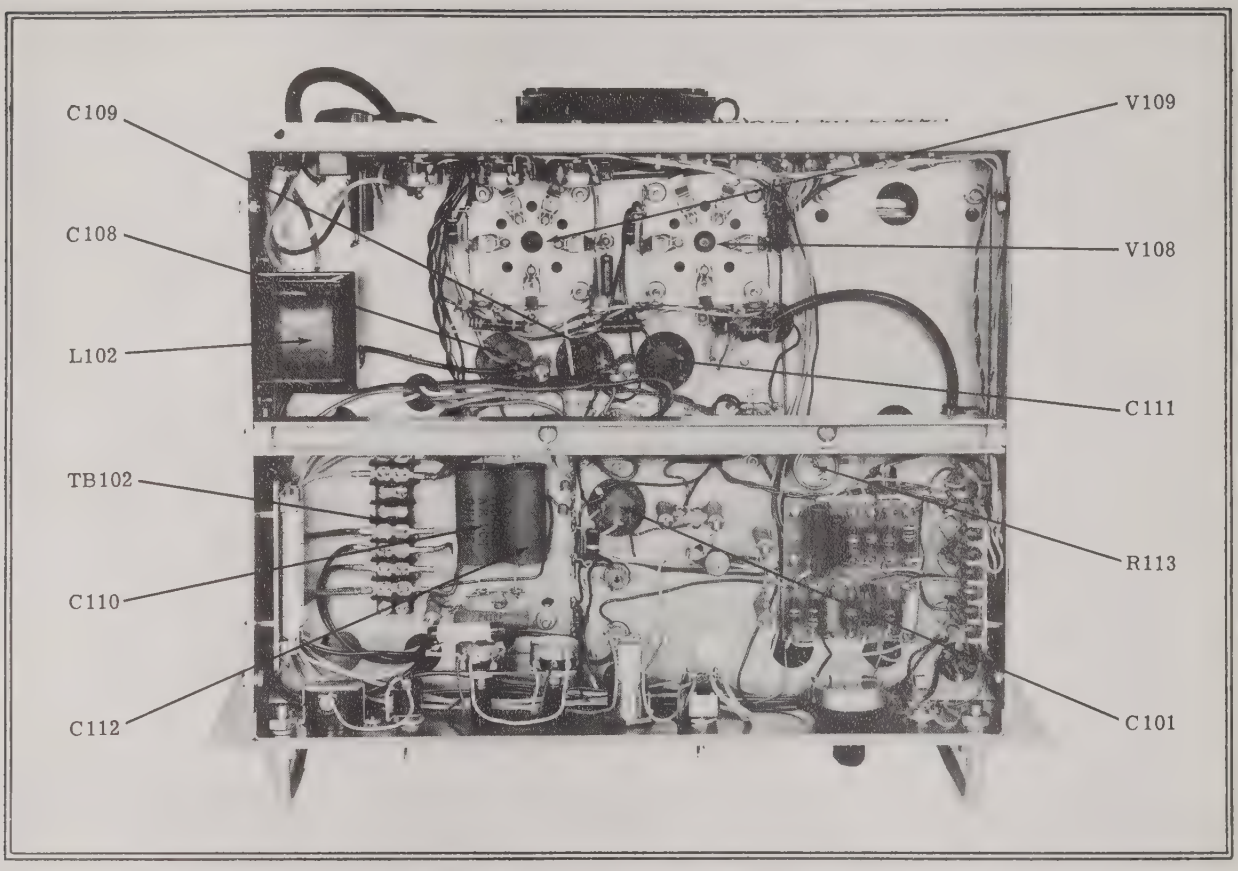
Method of Removing Oscillator and Power Supply Cabinet.

TROUBLESHOOTING CHART

SYMPTOM	CAUSE	REMEDY
No pilot lamp.	Faulty line cord.	Check plug and cable.
	Fuse F 101 blown.	Check for internal failure and replace fuse.
	Faulty lamp.	Replace lamp.
No power output.	OUTPUT switch OFF.	Throw ON.
	No plate voltage.	Troubleshoot Power Supply using high voltage technics. Check plate current on panel meter. No signal DC current should be 0.2 to 0.3 ampere. The full load DC current should be 0.66 ampere.
	Faulty oscillator.	Plug in external oscillator and test the amplifier. If amplifier is OK, troubleshoot the equipment oscillator.
	Faulty amplifier.	Measure AC voltage at test point TP-1 and TP-2.
		Replace 6AU6 or 12AU7 type tubes.



Method of Removing Power Supply Chassis from Bottom Assembly.



Bottom View of Model 250 Variable Frequency Power Supply.

AMPLIFIER TEST & ALIGNMENT

The following procedure can be used after repair or as a periodic electrical maintenance test of the amplifier.

a. Remove cabinet and plug power cord into line source.

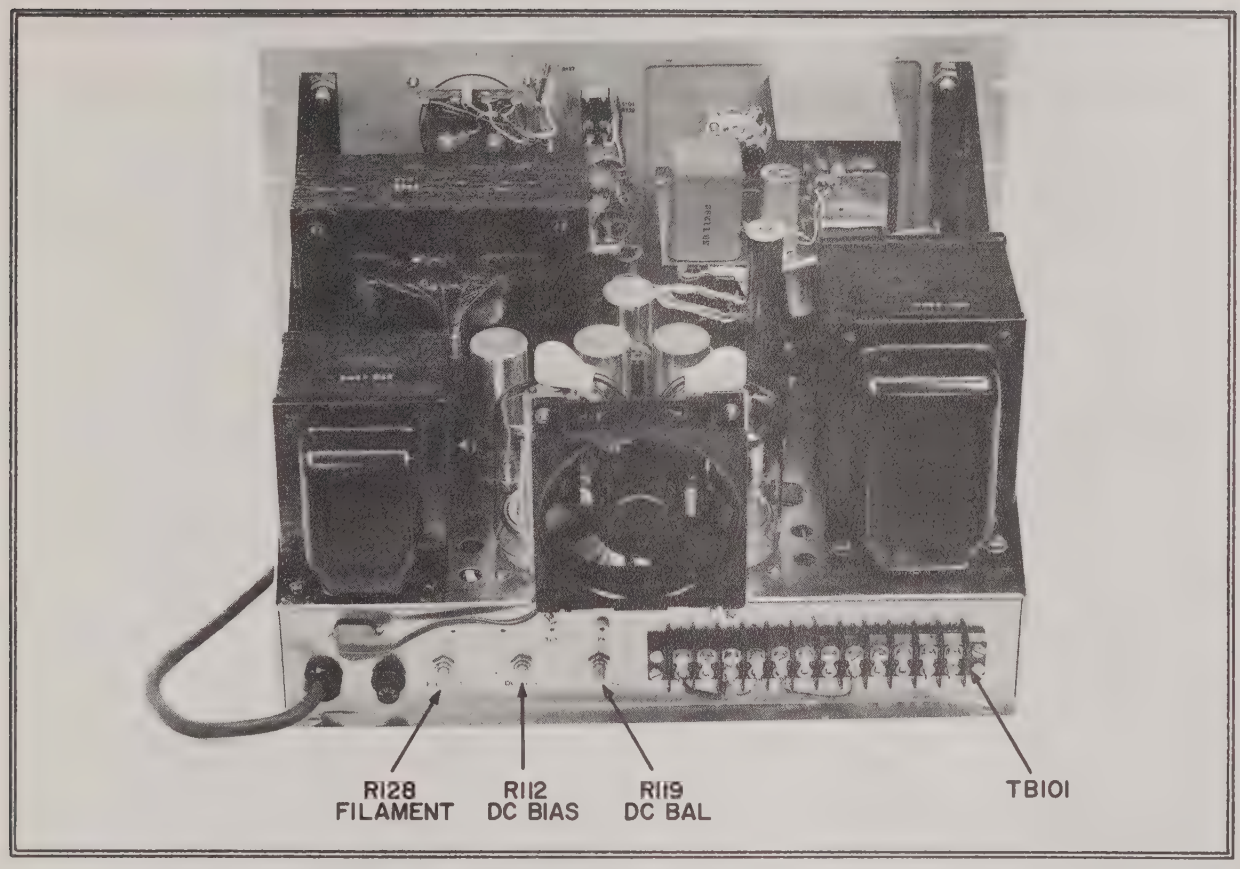
b. Rotate AMPLIFIER GAIN fully counter-clockwise and set NEGATIVE and POSITIVE FEEDBACK controls to zero. POWER and INTERNAL LOAD switches should be OFF. Connect two 150-ohm, 200-watt resistors in parallel to a 115-volt line cord and plug it into the output receptacle on the front panel. Connect an ammeter in series and a voltmeter across the load. Determine the ground side and connect an oscilloscope between chassis and the high side of the output. Connect a vacuum tube voltmeter across the output of an audio oscillator, then plug this test oscillator into the AMPLIFIER INPUT jack using a telephone plug. (Tip is high side.) Set the test oscillator voltage output to zero or, at least, less than one millivolt. Throw OUTPUT switch ON.

c. Throw POWER switch ON and observe plate current as output tubes warm up. This current should rise to about 0.2 ampere. If it rises over 0.66 ampere shut down equipment and remove the two type 7378 tubes (V108 and V109). The DC bias voltages on the grids are probably out of adjustment. Measure the DC bias voltage at test points TP-1 and TP-3 at the rear of the chassis to be equal and approximately -43 volts. If not, adjust DC BIAS (R112) for magnitude and DC BALANCE (R119) for balance between the voltages. Turn off power and replace the tubes. The DC plate current should then measure near 0.2 ampere. If not, adjust the R112 until 0.2 ampere zero signal plate current flows. Measure the voltages from TP-2 and TP-4 to ground. These voltages should be equal to each other within +10% or the lowest 7378 output tube may be weak. Check tube for power handling capacity and distortion before replacement, as these characteristics are the controlling factors.

d. Rotate AMPLIFIER GAIN control to maximum clockwise position. At 60 cps, adjust test oscillator output voltage until equipment output meter reads 115 volts when VOLTS OUTPUT AC switch lever is raised. Test oscillator voltage should be between .03 and 0.1 volt.

e. Measure the AC voltage with a VTVM at TP-1 and TP-3 which should be about 35 volts. Bring these voltages to balance by adjusting the AC BALANCE control (R113) on the rear of the chassis.

f. Raise VOLTS OUTPUT AC switch and turn NEGATIVE FEEDBACK control until output drops to about 10 volts. Increase input voltage from test oscillator to one volt (1.0 V) and readjust NEGATIVE FEEDBACK control until Power Supply output reads 115 volts.



Rear View of Chassis Model 250 Variable Frequency Power Supply.

g. Remove one 150-ohm resistor from the load. Throw INTERNAL LOAD switch ON and adjust the POSITIVE FEEDBACK control so that the addition of this internal load decreases the output voltage by about 0.5 volt. Readjust the NEGATIVE FEEDBACK control for 115 volts output. Switch the INTERNAL LOAD to OFF and replace the 150-ohm load resistor.

h. Check that no clipping of the output wave occurs at 120 volts, 75-ohm load with 115 volts power line voltage at 60 and 400 cycles.

i. Measure the total distortion at 115 volts output across the 75-ohm load at 60, 400, 800 and 2400 cycles using the external oscillator and note that the distortion is within 30% of the curve on page 20.

j. Throw the INTERNAL LOAD switch ON and disconnect the external load. Plug an unloaded variable autotransformer into the output receptacle; there should be no change in the output wave displayed on the oscilloscope.

HB-16940-2 OSC. TEST

Make sure amplifier is functioning properly and POSITIVE and NEGATIVE FEEDBACK adjustments are set in accordance with procedure explained under AMPLIFIER TEST AND ALIGNMENT.

1. Remove oscillator from front panel of equipment or remove cabinet. Disconnect plug P202 (shielded lead from oscillator to amplifier). Plug power cord into line supply.

2. Turn frequency selector control (on oscillator panel) to position marked 50 or 60, depending on line frequency.

3. Place switch (on oscillator panel) to OSC position.

4. Connect a 75-ohm load (two 150-ohm, 200-watt resistors in parallel) across amplifier output receptacle.

5. Place INTERNAL LOAD switch OFF.

6. Throw OUTPUT switch ON.

7. Center COARSE and FINE AMPLITUDE controls (arrows up).

8. Feed a 50 or 60 c/s (same as line frequency) 1-volt signal from an external test oscillator into AMPLIFIER INPUT jack.

9. Place POWER switch ON; front panel meter should rise to approximately 0.55 ampere. Raise VOLTS OUTPUT switch to AC position; panel meter should read 115 volts.

AC VOLTAGE CHART

TEST POINTS Amplifier Section (at 115 V output)	AC VOLTAGE 250 ohms Output Load	 75 ohms Output Load
Tube V 102 (6AU6)		
Pin 1 to GND	1.0 V	1.0 V
Pin 2 to GND	1.0	1.0
Pin 3 to GND	6.0	6.0
Pin 4 to GND	.012	.012
Pin 5 to GND	2.5	7.0
Pin 6 to GND	.0025	.330
Pin 7 to GND	1.0	1.0
Tube V 103 (12AU7)		
Pin 1 to GND	13.0	37.0
Pin 2 to GND	2.3	6.5
Pin 3 to GND	1.0	3.6
Pin 4 & 5 to GND	.010	.010
Pin 6 to GND	13.0	37.0
Pin 7 to GND	0.3	0.9
Pin 8 to GND	1.3	3.5
Pin 9 to GND	6.0	6.0
Tube V 104 (12AU7)		
Pin 1 to GND	.006	.018
Pin 2 to GND	13.0	37.0
Pin 3 to GND	13.0	37.0
Pin 4 & 5 to GND	.009	.010
Pin 6 to GND	.006	.018
Pin 7 to GND	13.0	37.0
Pin 8 to GND	13.0	37.0
Pin 9 to GND	6.0	6.0
TP-1	13.0	37.0
TP-3	13.0	37.0

10. Connect a vacuum tube voltmeter across tip (high side) of plug P202 and its shell (ground); adjust R206 (located behind oscillator front panel) to full counter-clockwise position.

11. Adjust COARSE and FINE AMPLITUDE controls for less than 0.1 volt across P202. Then adjust R206 for 1 volt across P202.

12. Throw switch on oscillator panel to SYNC and adjust R214 (across from R206) for 1 volt at P202.

13. Disconnect test oscillator input and replace plug P202 in receptacle J102.

14. Raise VOLTS OUTPUT switch to AC position; meter should read 115 volts; if not, adjust COARSE AMPLITUDE control. Repeat with OSC-SYNC switch in OSC position.

15. Remove one of the 150-ohm, 200-watt resistors from the load and cycle the switch marked INTERNAL LOAD on and off; the variation of output voltage should be less than ±0.1%. If not, adjustment of the POSITIVE FEEDBACK setting should bring the load regulation within tolerance.

16. Plug the power cord of the Model 250 into a 1000 VA variable auto-transformer and change the line voltage ±5 volts. Regulation to line for this change should be less than ±0.1%.

17. Measure total distortion at 115 volts output across 100 VA or 200 VA load at 50, 60, 400, 800, and 1000 c/s. Check values obtained against curves shown in DESCRIPTION Section for HB-16940-2 Oscillator.

HB-12850-2 OSC. TEST

Make sure amplifier is functioning properly and POSITIVE and NEGATIVE FEEDBACK adjustments are set in accordance with procedure explained under AMPLIFIER TEST AND ALIGNMENT.

1. Remove oscillator from front panel of equipment or remove cabinet. Disconnect plug P202 (shielded lead from oscillator to amplifier). Plug power cord into line supply.

DC VOLTAGE CHART

TEST POINTS Amplifier Section (at 115 V output)	DC VOLTAGE
Tube V 102 (6AU6)	
Pin 1 to GND	0
Pin 2 to GND	1.25
Pin 3 to GND	0
Pin 4 to GND	0
Pin 5 to GND	80
Pin 6 to GND	52
Pin 7 to GND	. 1.25
Tube V 103 (12AU7)	
Pin 1 to GND	-46
Pin 2 to GND	-175
Pin 3 to GND	-174
Pin 4, 5 & 9 to GND	0
Pin 6 to GND	-45
Pin 7 to GND	-175
Pin 8 to GND	-174
Tube V 104 (12AU7)	
Pin 1 to GND	150
Pin 2 to GND	-45
Pin 3 to GND	-45
Pin 4, 5 & 9 to GND	0
Pin 6 to GND	150
Pin 7 to GND	-45
Pin 8 to GND	-43
TP-1	-43
TP-2	1.3
TP-3	-43
TP-4	1.3
J103 - Pin 5	275.

2. Turn frequency selector control (on oscillator panel) to 50 or 60 c/s, depending on line frequency.

3. Place switch (on oscillator panel) to OSC position.

4. Connect a 75-ohm load (two 150-ohm, 200-watt resistors in parallel) across amplifier output.

5. Place INTERNAL LOAD switch OFF and OUTPUT switch ON.

6. Rotate amplitude control marked VOLTS 115 to its center position (arrow pointing up).

7. Feed a 50 or 60 c/s (same as line frequency) 1-volt signal from an external test oscillator into AMPLIFIER INPUT jack.

8. Throw POWER switch ON; front panel meter should rise to about 0.55 ampere. Raise VOLTS OUTPUT switch to AC position; panel meter should read 115 volts.

9. Connect a vacuum tube voltmeter across tip (high side) of plug P202 and its shell (ground); against R202 (located behind front panel of osc.) to full counter-clockwise position.

10. Remove hole button and adjust R206 and amplitude control marked VOLTS 115 for less than 0.1 volt at P202. Then adjust R202 for 1 volt across P202.

11. Throw switch on oscillator panel to SYNC and adjust R208 (near R202 back of panel) for 1 volt across P202.

12. Disconnect test oscillator input and replace plug P202 in receptacle J102.

13. Raise VOLTS OUTPUT switch to AC position; meter should read 115 volts; if not, adjust amplitude control marked VOLTS 115. Repeat with OSC-SYNC switch in OSC position.

14. Remove one of the 150-ohm, 200-watt resistors from the load and cycle the switch marked INTERNAL LOAD on and off; the variation of output volt-

age should be less than ±0.1%. If not, adjustment of the POSITIVE FEEDBACK control should bring the load regulation within tolerance.

15. Plug the power cord of the Model 250 into a 1000 VA variable auto-transformer and change the line voltage ±5 volts. Regulation to line for this change should be less than ±0.1%.

16. Measure total distortion at 115 volts output across 100 VA or 200 VA load at 50, 60, 400, 800, and 1000 c/s. Check values obtained against curves shown in DESCRIPTION Section for HB-12850-2 Oscillator.

HB-12800 OSC. TEST

Make sure amplifier is functioning properly and POSITIVE and NEGATIVE FEEDBACK adjustments are set in accordance with procedure explained under AMPLIFIER TEST AND ALIGNMENT.

1. Remove oscillator from front panel of equipment or remove cabinet and plug power cord into line receptacle.

2. Connect a 75-ohm load (two 150-ohm, 200-watt resistors in parallel) across amplifier output.

3. Place INTERNAL LOAD switch OFF. Throw OUTPUT switch ON.

4. Unplug shielded lead from oscillator to amplifier and connect a vacuum tube voltmeter across tip (high side) of plug P301 and adjust R309 (located behind front panel) for 1.75 volts across P301.

5. Replace plug P301 into receptacle J102.

6. Raise VOLTS OUTPUT switch to AC position; meter on panel should read 115 volts.

7. Connect an electronic counter across amplifier output and check frequency calibration.

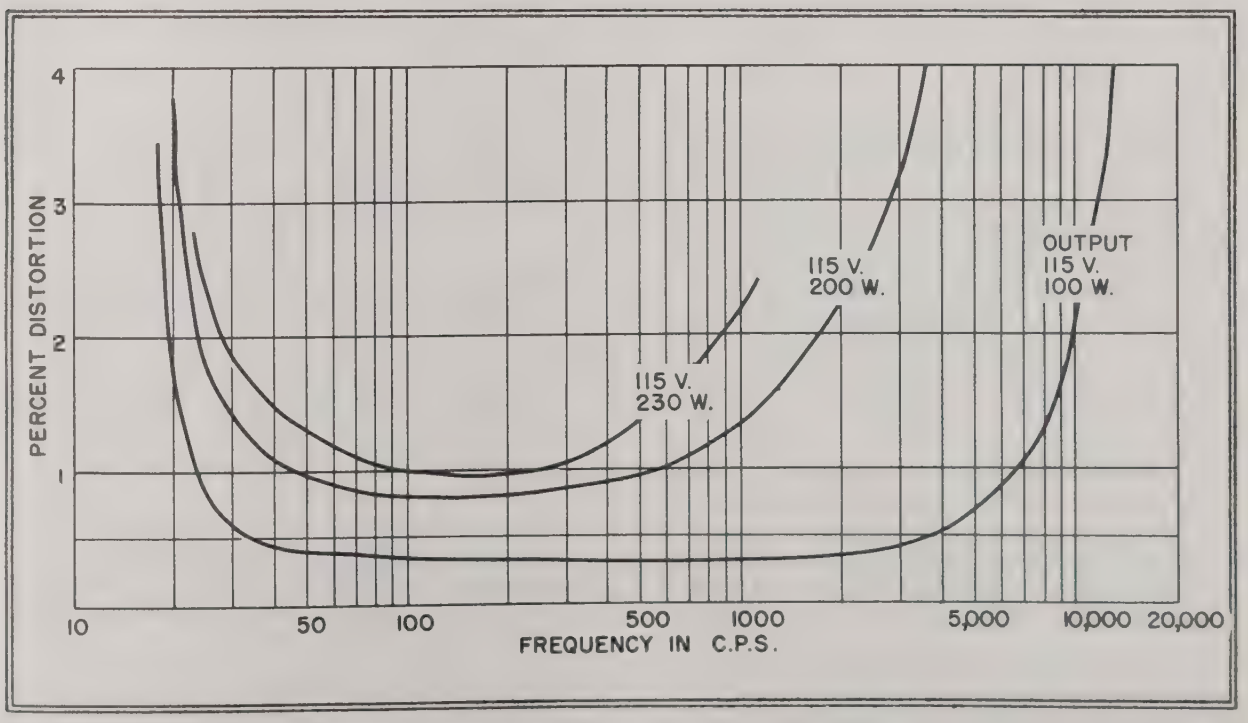
8. Adjust trimmer C301 (located behind front panel) for ±2% at the high, center and low end of each frequency range.

9. Remove one of the 150-ohm, 200-watt resistors from the load and cycle the switch marked INTERNAL LOAD on and off; the variation of output voltage should be less than ±1%. If not, adjustment of the POSITIVE FEEDBACK setting should bring the load regulation within tolerance.

10. Measure total distortion at 115 volts output across 100 VA or 200 VA load at various frequencies. Check values obtained against curve shown in DESCRIPTION Section.

HB-12900 PREC. OSC. TEST

This oscillator is tested in the same manner as the HB-16940-2 or HB-12850-2 oscillators, except the loop is broken by the SET LEVEL switch, and the output of the oscillator is set to drive the amplifier to 115 volts at its output.



Harmonic Distortion at Various Loads Using External Osc.

Table of Electrical Parts

*Recommended Spare Parts for Overseas Use

RFL PART NO.	NAME OF PART AND DESCRIPTION	DIAGRAM SYMBOL
	MODEL 250 POWER AMPLIFIER SECTION	
*HA-9362	ADAPTER: 3-wire plug to 2-wire receptacle.	
*HA-12209	BRIDGE, rectifier; meter.	CR105
*HA-12518	CAPACITOR, electrolytic 30 x 20 x 20/500 v.	C101
HA-12971	CAPACITOR, met. paper: 1 mf, 200 v, ±20%. (2)	C102, C107
*HA-12970	CAPACITOR, electrolytic: aluminum foil, 200 mf, 3 v.	C103
H-1080-194	CAPACITOR, met. paper: 2 mf, 200 v, ±20%.	C104
H-1080-72	CAPACITOR, mica: 1000 pf, ±10%, 500 v.	C105
HA-13868	CAPACITOR, mylar tub.: 0.1 mf, 400 v, ±10%.	C106
*HA-12659	CAPACITOR, elect. twist-prong: w/ins. tube, 80 mf, 500 v. (3)	C108, C109, C111
*HA-12519	CAPACITOR, electrolytic: 30 mf, 500 v. (2)	C110, C112
*HB-9931	CHOKE, smoothing: 3 hy. at 150 ma, 90 ohms, 2000 v, RMS insulation.	L102
*HB-12840	CHOKE: 20 hy. at 0.6 amp., 10 hy. at .06 amp., 20 ohms, 3000 v hipot.	L101
*HA-10087	FAN, Muffin "Venturi Fan": 4-11/16 sq. x 1½ thick.	BL101
*HA-2870	FUSE: 10 amp, 4 AB, 115 v max.	F101
*HA-2873	LAMP, incandescent.	I101
HA-2856	LIGHT, indicator: red.	E101
*HB-10844	METER: 1 ma, 100 ohms.	M101
*HA-11967	RECEPTACLE: convenience AC outlet.	J105
*HA-17229	DIODE, silicon: 3600 VPI (2)	CR101, CR102
*HA-12946	RECTIFIER, silicon: 600 VPI, 500 ma. (2)	CR103, CR104
*HA-12936	RESISTOR, variable WW: 25 K, ±10%, 3 w.	R101
H-1100-361	RESISTOR, fixed WW: 1 ohm, ±5%, 3 w (axial lead type).	R102
H-1009-535	RESISTOR, fixed comp: 10 K, ±10%, 1 w.	R103
H-1009-332	RESISTOR, fixed comp: 220 K, ±10%, 1 w.	R114
H-1009-475	RESISTOR, fixed comp: 120 K, ±10%, 1 w.	R104
H-1009-467	RESISTOR, fixed comp: 1.8 K, ±10%, 1 w.	R105

Table of Electrical Parts

*Recommended Spare Parts for Overseas Use

RFL PART NO.	NAME OF PART AND DESCRIPTION	DIAGRAM SYMBOL
H-1009-305	RESISTOR, fixed comp: 470 K, ±10%, 1 w.	R106
H-1009-649	RESISTOR, fixed comp: 3.3 K, ±10%, 1 w.	R107
HA-12941	RESISTOR, fixed WW: 2 K, ±10%, 10 w. (2)	R108, R132
H-1009-426	RESISTOR, fixed comp: 100 K, ±10%, 1 w.	R109
H-1009-27	RESISTOR, fixed comp: 180 K, ±5%, 1 w.	R110
*HA-12658	RESISTOR, variable WW: 25 K, ±10%, 2 w.	R112
*HA-7922	RESISTOR, variable comp: 250 K, ±20%, 2 w, linear taper, locking type.	R113
HA-12940	RESISTOR, fixed WW: 1 K, ±10%, 10 w. (3)	R115, R129, R133
H-1009-499	RESISTOR, fixed comp: 47 K, ±10%, 1 w. (3)	R116, R123, R111
H-1009-308	RESISTOR, fixed comp: 330 K, ±10%, 1 w.	R117
H-1009-321	RESISTOR, fixed comp: 220 K, ±10%, 2 w.	R118
*HA-9956	RESISTOR, variable WW: 10 K, ±10%, 2 w.	R119
H-1009-420	RESISTOR, fixed comp: 33K, ±10%, 1 w.	R120
H-1009-428	RESISTOR, fixed comp: 4.7 K, ±10%, 1 w.	R121
H-1009-318	RESISTOR, fixed comp: 4.7 meg., ±10%, 1 w.	R122
HA-9942	RESISTOR, variable WW: 100 ohms, ±10%, 2 w. (2)	R124, R128
HA-12, 933	RESISTOR, variable WW: 500 ohms, ±10%, 2 w.	R125
H-1100-27	RESISTOR, fixed WW: 1 ohm, 10 w, ±5%.	R126
HA-12939	RESISTOR, fixed WW: 25 K, ±10%, 25 w.	R127
HA-12942	RESISTOR, fixed WW: 30 K, ±10%, 10 w. (3)	R130, R131, R134
H-1009-658	RESISTOR, fixed comp: 1K, ±10%, 2 w.	R135
HA-12660	RESISTOR, fixed WW: prec. min., 1 ohm, ±1%, 5 w, axial lead.	R136
H-1510-261	RESISTOR, prec. carbon film: 900 ohms, ±1%, ½ w. (2)	R137, R139
HA-12937	RESISTOR, fixed WW: axial leads, min. precision, 9-ohm, ±1%, 5 w. (2)	R138, R141
*H-1510-262	RESISTOR, prec. carbon film: 122 K, ±1%, ½ w.	R140
HA-12938	RESISTOR, fixed WW: 250 ohms, ±10%, 100 w.	R142

Table of Electrical Parts

*Recommended Spare Parts for Overseas Use

RFL PART NO.	NAME OF PART AND DESCRIPTION	DIAGRAM SYMBOL
H-1009-674	RESISTOR, fixed comp: 47 ohms, ±10%, 1 w. (2)	R143, R145
H-1009-201	RESISTOR, fixed comp: 1 K, ±10%, 1 w. (2)	R144, R146
*HA-10857	SWITCH, lever.	S102
HA-7037	SWITCH: toggle, d. p. s. t.	S101
HA-9937	SWITCH: toggle, s. p. s. t. (2)	S103, S104
*HB-12842	TRANSFORMER: 250 VA; 20-30,000 cps at 3 db.	T101
*HB-12841	TRANSFORMER: pri. 115/115 v, 50/60 cps; sec. 6.3 v at 9 A, 5.0 v at 2.5 A, 1700 VCT at 0.6 ADC at 0.1 ADC.	T102
*HA-3665	TUBE, electron: 0A2. (2)	V101, V107
*HA-3562	TUBE, electron: 6AU6.	V102
*HA-3563	TUBE, electron: 12AU7.	V103, V104
*HA-4863	TUBE, electron: 5Y3GT.	V105
*HA-3666	TUBE, electron: 0B2.	V106
*HA-12974	TUBE, electron: 7378. (2)	V108, V109
	RC OSCILLATOR UNIT HB-12800	
HA-6975	CAPACITOR, variable: ceramic; 7-45 pf.	C301
*HA-10865	CAPACITOR, variable: 13-616 pf.	C302 A & B
H-1080-107	CAPACITOR: sil. mica; 180 pf ±5%, 500 v.	C303
H-1080-122	CAPACITOR: sil. mica; 500 v (factory value).	C304
*HA-10862	CAPACITOR: dry electrolytic; 16 μf, 450 v.	C305, C307, C308
*HA-20191	DIODE, zener: 10 w, 200 v, silicon 1N3015.	CR301
*HA-10864	LAMP	I301
H-1510-248	RESISTOR, fixed: comp; 1.8 meg., ±1%, 1 w.	R301
H-1510-246	RESISTOR, fixed: comp; 470K ±1%, 1 w.	R302, R314
H-1510-245	RESISTOR, fixed: comp; 110 K ±1%, 1 w.	R303
H-1009-473	RESISTOR, fixed: comp; 680 ohms ±10%, ½ w.	R304
H-1009-350	RESISTOR, fixed: comp; 4.7K ±10%, ½ w.	R305
H-1510-250	RESISTOR, fixed: comp; 18 meg. ±1%, 2 w.	R306
H-1510-249	RESISTOR, fixed: comp; 4.7 meg. ±1%, 1 w.	R307

Table of Electrical Parts

*Recommended Spare Parts for Overseas Use

RFL PART NO.	NAME OF PART AND DESCRIPTION	DIAGRAM SYMBOL
H-1510-247	RESISTOR, fixed: comp; 1.1 meg. ±1%, 1 w.	R308
*HA-12220	RESISTOR, variable: WW; 750 ohms ±1%, 2 w.	R309
H-1100-263	RESISTOR, fixed: WW; 5 K ±10%, 20 w.	R310
H-1009-202	RESISTOR, fixed: comp; 330 ohms ±10%, 1 w.	R311
H-1009-508	RESISTOR, fixed: comp; 100 K ±10%, 1 w.	R312, R313
H-1009-674	RESISTOR, fixed: comp; 47 ohms ±10%, 1 w.	R315
H-1009-535	RESISTOR, fixed: comp; 10 K ±10%, 1 w.	R316
*HA-8358	SWITCH, rotary: 2-pole, 6 positions, nonshorting.	S301
*HA-3562	TUBE, electron: min. 6AU6.	V301
*HA-10854	TUBE, electron: 6CL6.	V302
*HA-6517	MECHANISM, Vernier Drive.	
	LC REGULATING OSCILLATOR HB-12850-2	
H-1080-68	CAPACITOR, fixed: silver mica; 3900 μf ±10%, 500 v.	C201
HA-9934	CAPACITOR, variable: 3 x 365 pf.	C202
H-1080-233	CAPACITOR, fixed: silver mica; .0091 μf ±1%, 500 v.	C203
HA-12064	CAPACITOR, fixed: mylar; .850 μf (factory value) 200 v.	C204
H-1080-235	CAPACITOR, fixed: sil. mica; .002 μf ±1%, 500 v.	C205
H-1080-237	CAPACITOR, fixed: sil. mica; .004 μf ±1%, 500 v.	C207
H-1080-236	CAPACITOR, fixed: sil. mica; .003 μf ±1%. 500 v.	C208
H-1080-234	CAPACITOR, fixed: sil. mica; .001 μf ±1%, 500 v.	C209
H-1007-431	CAPACITOR, fixed: mylar; 1.3 μf ±2%, 200 v.	C210
Fact. Value	CAPACITOR, fixed: mylar; approx. 0.2 μf, 200 v.	
*HA-12858	TUBE, Ballast, high gain thermal regulator.	E201
	(*HA-12862 ELEMENT ASSEMBLY: low gain thermal reg. alternate E201.)	
*HA-6941-1	COIL, toroid, 9 hy.	L201
HA-12866	RESISTOR, fixed: WW; axial-lead; 1500 ohms ±5%, 5 w.	R201
HA-9944	RESISTOR, variable: WW; 200 ohms ±10%, 2 w.	R202

Table of Electrical Parts

*Recommended Spare Parts for Overseas Use

RFL PART NO.	NAME OF PART AND DESCRIPTION	DIAGRAM SYMBOL
H-1100-355	RESISTOR, fixed: WW; axial-lead; 250 ohms ±5%, 5 w.	R203, R207
HA-12856	RESISTOR, variable: WW; 50 ohms ±10%, 4 w.	R204
HA-12865	RESISTOR, fixed: WW; axial-lead; 150 ohms ±5%, 5 w.	R205
HA-12861	RESISTOR, variable: WW; 1000 ohms ±10%, 4 w.	R206
H-1100-293	RESISTOR, fixed: WW; axial-lead; 100 ohms ±5%, 5 w.	R208
HA-9939	RESISTOR, variable: WW; 100 ohms ±10%, 2 w.	R209
*HA-14287	THYRITE, disc.	R210
Fact. Value	RESISTOR, fixed: WW; axial-lead; approx. 75 ohms, 5 w.	
*HB-9925	SWITCH, rotary: 2-pole, 10 positions.	S201
*HA-12855	SWITCH, rotary: 1 pole, 5 positions.	S202
HA-7036	SWITCH, toggle: d. p. d. t. (ST52N)	S203
*HB-11292	TRANSFORMER, feedback.	T202
	PRECISION 400 CPS REGULATING OSCILLATOR HB-12900	
H-1007-242	CAPACITOR, electrolytic: 20 μf, 350 v.	C1
H-1080-68	CAPACITOR, mica dielectric: 3900 pf ±10%, 500 v.	C2
*HA-20191	DIODE, zener: 10 w, 200 v, silicon 1N3015.	CR1
*HA-12858	TUBE, ballast.	E1
*HB-9468	FILTER, band-pass, 400 cps.	FL1
*HA-12906	OSCILLATOR, tuning fork resonator, 400 cps.	OSC
*HA-12907	CORD, jumper (½).	P2
*HA-12905	RESISTOR, variable: comp; 500 K ±10%, ½ w.	R2
H-1009-428	RESISTOR, fixed: comp; 4700 ohms ±10%, 1 w.	R3
H-1009-418	RESISTOR, fixed: comp; 1.5 K ±10%, ½ w.	R4
*HA-12861	RESISTOR, variable: WW; 1 K ±10%, 4 w.	R5
HA-12865	RESISTOR, fixed: WW; axial-lead; 150 ohms ±5%, 5 w.	R6
*HA-12856	RESISTOR, variable: WW; 50 ohms ±10%, 4 w.	R7
H-1009-201	RESISTOR, fixed: comp; 1 K ±10%, 1 w.	R8
H-1009-617	RESISTOR, fixed: comp; 470 ohms ±10%, ½ w.	R9
*HB-11292	TRANSFORMER, feedback.	T1

Table of Electrical Parts

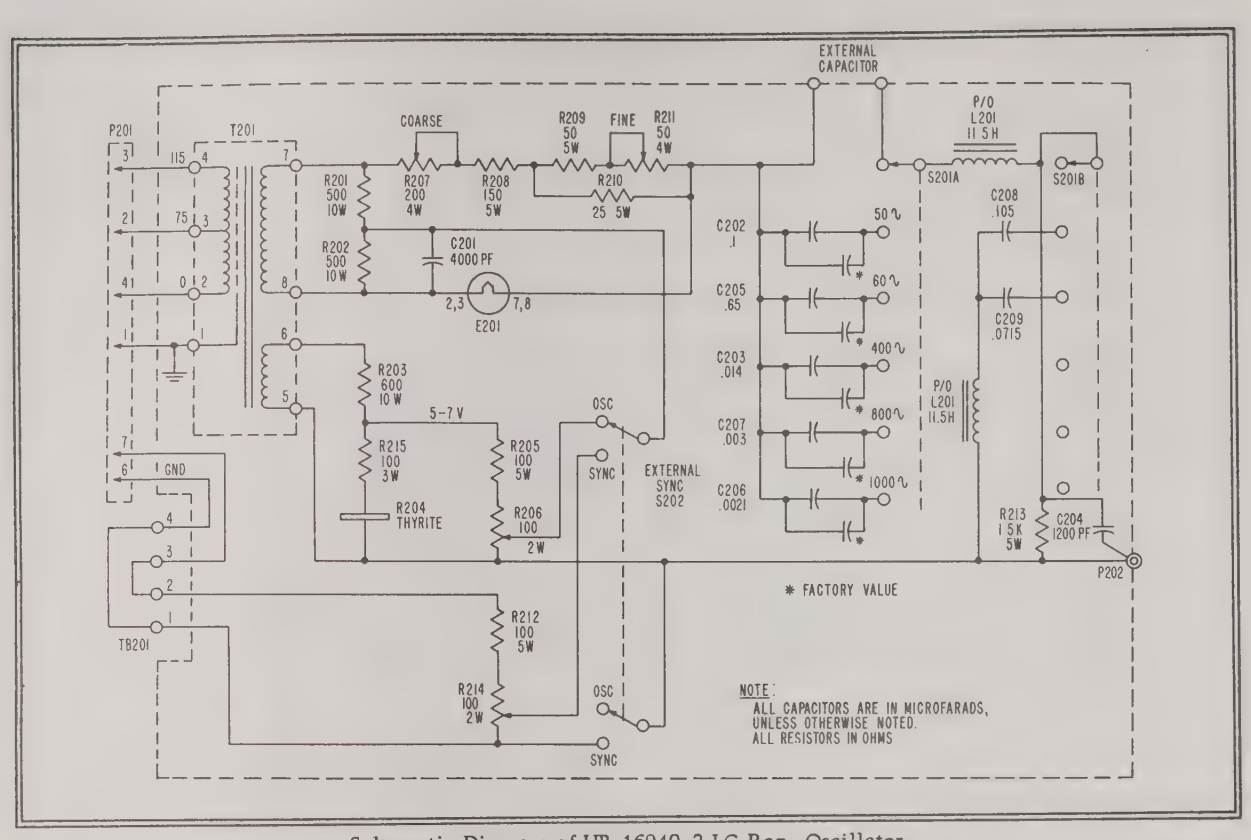
*Recommended Spare Parts for Overseas Use

RFL PART NO.	NAME OF PART AND DESCRIPTION	DIAGRAM SYMBOL
HA-5587	SWITCH, toggle, s.p.d.t.	S1
*HA-3563	TUBE, electron: 12 AU7.	V1
	LC REGULATING OSCILLATOR HB-16940-2	
H-1080-288	CAPACITOR, dur-mica: .004 μf ±2%, 500 v.	C201
HA-13815	CAPACITOR, mylar: plastic case; 1 μf ±10%, 100 v.	C202
H-1007-356	CAPACITOR, polystyrene: .014 μf ±2%, 100 v. (plastic case)	C203
H-1080-252	CAPACITOR, dur-mica: .0012 μf ±5%, 500 v.	C204
H-1007-455	CAPACITOR, mylar: 0.65 μf ±2%, 100 v.	C205
H-1080-207	CAPACITOR, sil. mica: .0021 μf ±2%, 500 v.	C206
H-1080-197	CAPACITOR, sil. mica: .003 μf ±2%, 500 v.	C207
HA-16049	CAPACITOR, mylar: .105 μf ±2%, 200 v. (plastic case)	C208
H-1007-348	CAPACITOR, polystyrene: .0715 μf ±2%, 100 v, plastic case 1-3/8" x .406 (max.)	C209
Fact. Value	CAPACITOR, sil. mica: factory value (range from .001 - 0.9 μf) ±2%, 500 v.	
*HA-12858	TUBE, Ballast.	E201
*HB-18590	Notch Filter Assembly.	L201
*HA-14804	CORD, jumper. ($\frac{1}{2}$)	P202
H-1100-193	RESISTOR, fixed: WW; 500 ohms ±10%, 10 w.	R201, R202
H-1100-292	RESISTOR, fixed: WW; 600 ohms ±5%, 10 w.	R203
*HA-14287	THYRITE, disc.	R204
H-1100-293	RESISTOR, fixed: WW; 100 ohms ±5%, 5 w, axial-lead.	R205, R212
*HA-9939	RESISTOR, variable: WW; 100 ohms ±10%, 2 w.	R206, R214
*HA-14262	RESISTOR, variable: WW; 200 ohms ±10%, 4 w.	R207
HA-13850	RESISTOR, fixed: WW; 150 ohms ±10%, 5 w.	R208

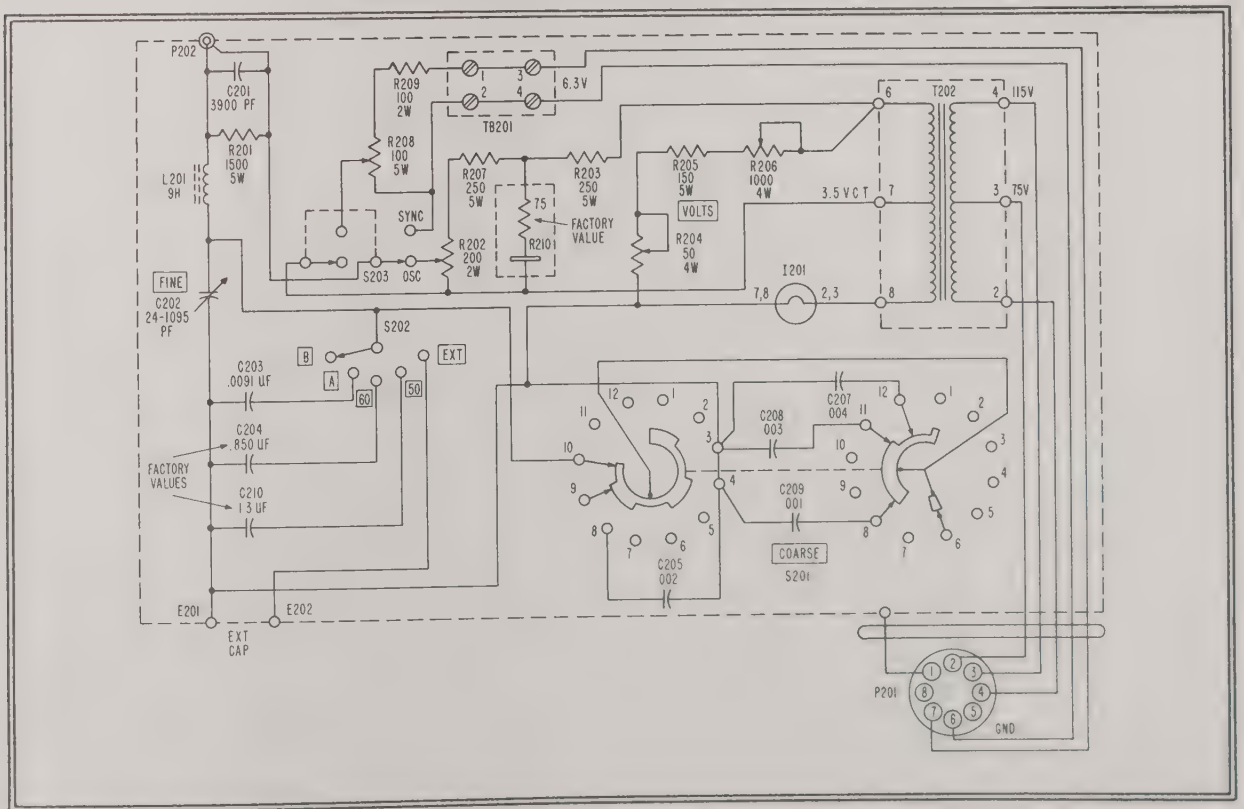
Table of Electrical Parts

*Recommended Spare Parts for Overseas Use

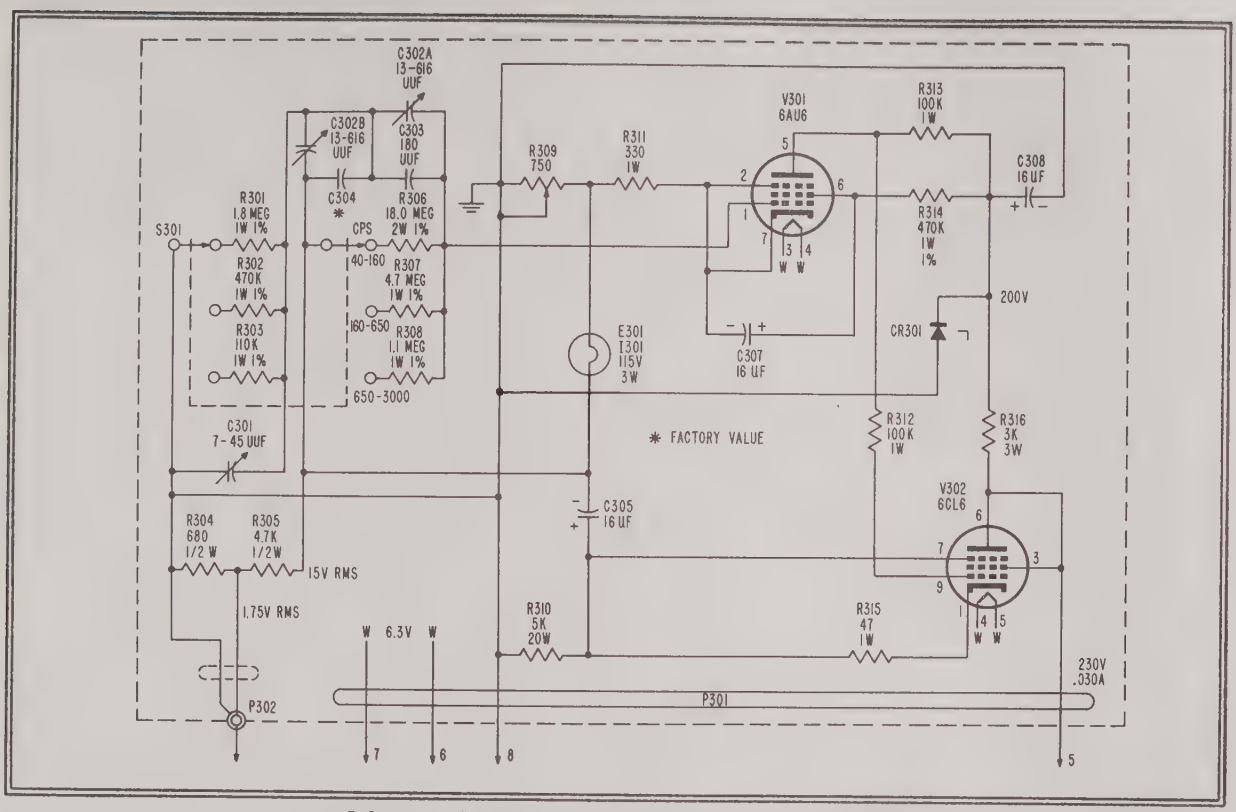
RFL PART NO.	NAME OF PART AND DESCRIPTION	DIAGRAM SYMBOL
H-1100-262	RESISTOR, fixed: WW; 50 ohms ±10%, 5 w.	R209
HA-13862	RESISTOR, fixed: WW; 25 ohms ±10%, 5 w.	R210
*HA-12856	RESISTOR, variable: WW; 50 ohms ±10%, 4 w.	R211
HA-12866	RESISTOR, fixed: WW; 1500 ohms ±5%, 5 w, axial-lead.	R213
H-1220-33	RESISTOR, fixed: WW; 100 ohms ±5%, 3 w, axial-lead.	R215
*HA-8358	SWITCH, miniature ceramic: 2-pole, 6 positions, nonshorting.	S201
HA-7036	SWITCH, toggle: d. p. d. t. (ST52N).	S202
*HB-14261	TRANSFORMER, feedback: 115/75 v pri., 2-35 v sec. 50-20,000 cycles.	T201



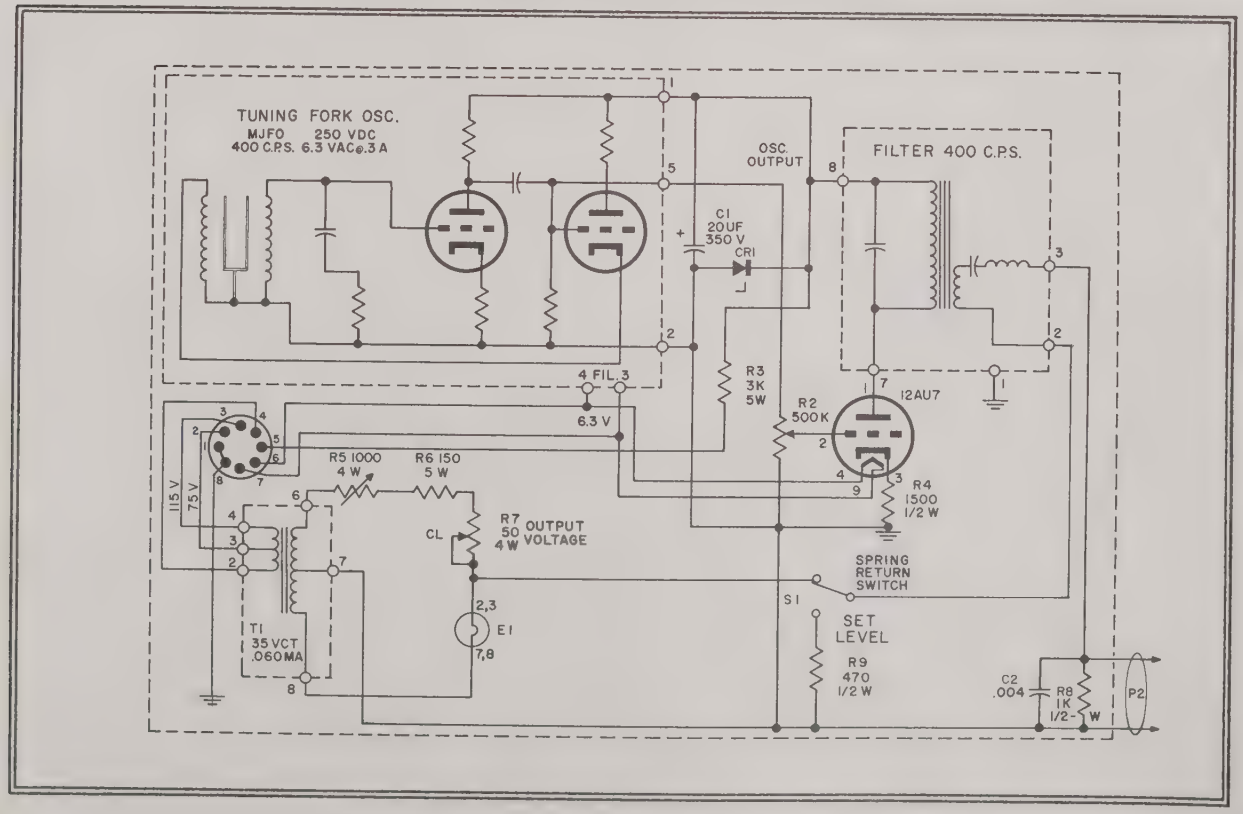
Schematic Diagram of HB-16940-2 LC Reg. Oscillator.



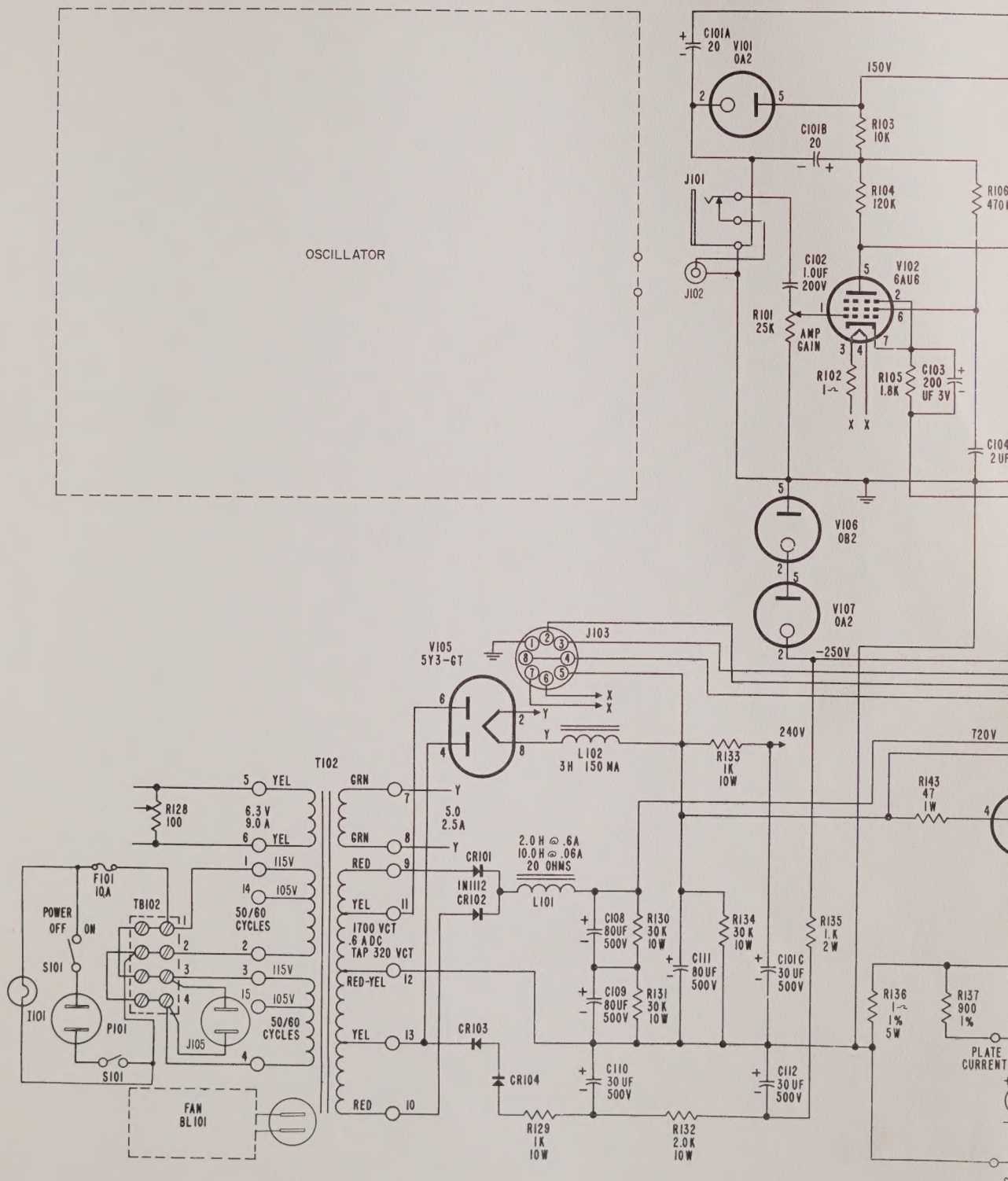
Schematic Diagram of HB-12850-2 LC Reg. Oscillator.

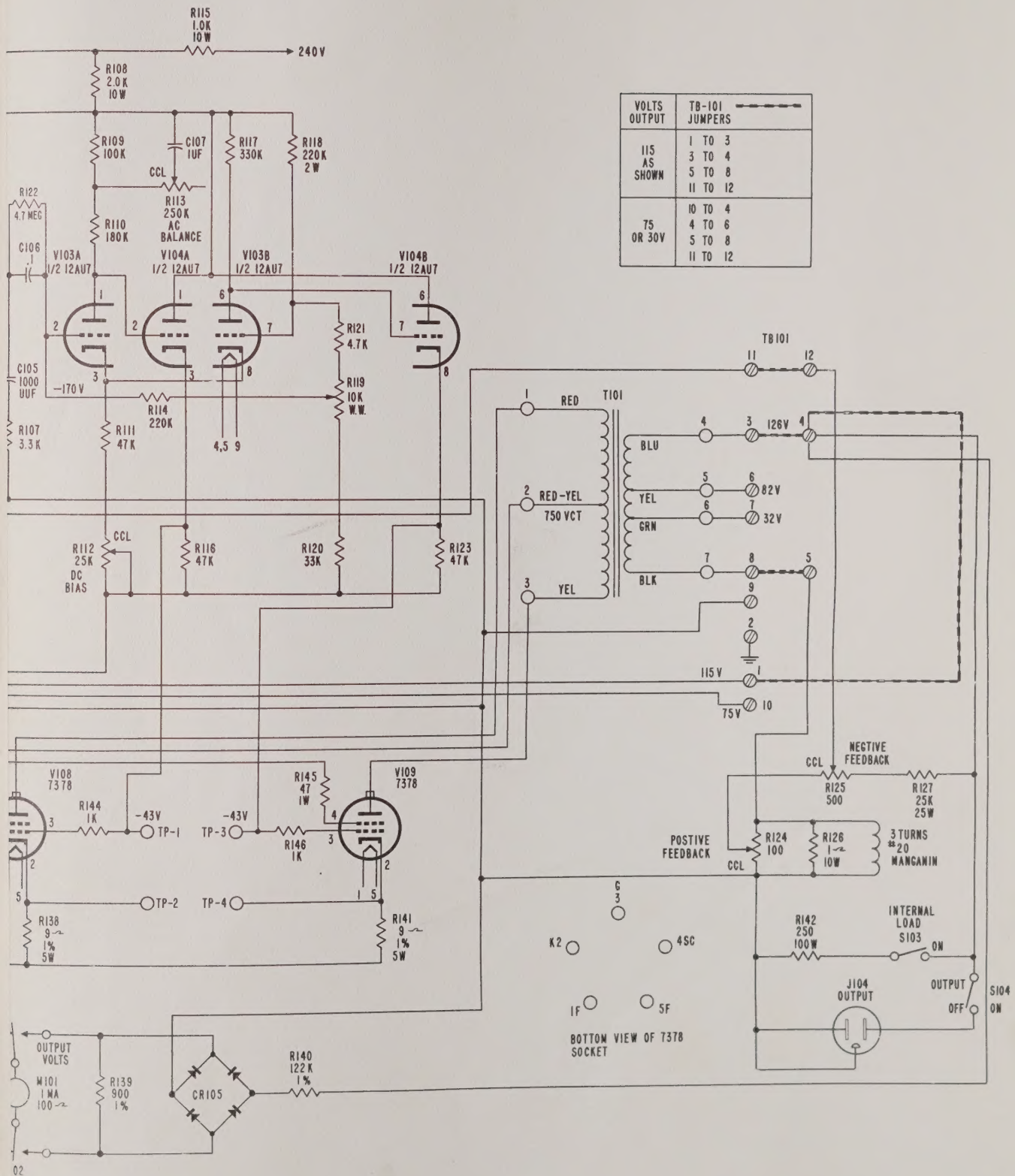


Schematic Diagram of HB-12800 RC Reg. Oscillator.



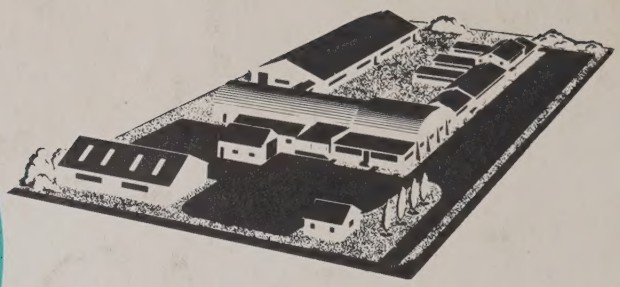
Schematic Diagram of HB-12900 Precision Reg. Oscillator.


OSCILLATOR
C101A 20
V101 0A2
150V
C101B 20
R103 10K
J101
R104 120K
J102
C102 1.0UF 200V
V102 6AU6
R101 25K
AMP GAIN
R102 1~
R105 1.8K
C103 200 UF 3V
V106 0B2
V107 0A2
-250V
V105 5Y3-GT
J103
X
X
Y
Y
L102 3H 150 MA
240V
R133 1K 10W
720V
R143 47 1W
T102
R128 100
6.3 V 9.0 A
5.0 2.5A
1700 VCT .6 ADC TAP 320 VCT
2.0 H @ .6A 10.0 H @ .06A 20 OHMS
CR101
IN1112 CR102
L101
C108 80UF 500V
R130 30 K 10W
C111 80UF 500V
R134 30 K 10W
C101C 30 UF 500V
R135 1.K 2W
C109 80UF 500V
R131 30 K 10W
R136 1~ 1% 5W
R137 900 1%
PLATE CURRENT
CR103
CR104
C110 30 UF 500V
C112 30 UF 500V
R129 1K 10W
R132 2.0K 10W
F101 10A
TB102
POWER OFF ON
S101
I101
P101
J105
115V
105V
50/60 CYCLES
FAN BL101



VOLTS OUTPUT	TB-101 JUMPERS
115 AS SHOWN	1 TO 3 3 TO 4 5 TO 8 11 TO 12
75 OR 30V	10 TO 4 4 TO 6 5 TO 8 11 TO 12

Schematic Diagram of Model 250 Variable Frequency Power Supply.



Warranty

The Model 250 Variable Frequency Power Supply carries a warranty of 12 months from date of delivery for replacement of any part, except tubes, which fails during normal operation or service. A deficient part should be returned to the factory, shipping charger prepaid, for replacement f. o. b. Boonton, N. J.

Radio Frequency Laboratories, Inc.
BOONTON, NEW JERSEY, U.S.A.

Manufacturers of

MAGNETICS EQUIPMENT

POWER SUPPLIES

SPECIAL HARDWARE

PRECISION CALIBRATION STANDARDS

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LABORATORIES, INC.
Boonton, New Jersey, U. S. A.

DESIGNERS AND MANUFACTURERS SINCE 1922